User's Manual

Model 805

Temperature Controller

This manual applies to instruments with Serial Numbers from 0 to 17999.

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SECTION I

GENERAL INFORMATION

1.1 INTRODUCTION

The information contained in this operations manual is for the installation, operation, remote programming and option and accessory information for the Lake Shore Cryotronics, Inc. Model 805 Temperature Controller. This manual also contains performance nd calibration procedures, schematics, component layouts and a replaceable parts list.

This section contains general information for the Lake Shore Cryotronics, Inc. 805 Temperature Controller. Included is an instrument description, specifications, instrument identification, option and accessory information.

1.2 DESCRIPTION

The 805 Temperature Controller is a microprocessor based instrument which provides true analog control. It accepts inputs from up to two sensors and displays the temperature with up to 4 digits of resolution in K, °C or °F. It displays voltage for diodes to 1 millivolt, and ohms for resistors to four places.

The dual sensor input allows the user to monitor temperature at more than one point. Sensor select pushbuttons on the front panel enable the user to display either input at will. The system control sensor is selected via a rear-panel toggle switch with the choice indicated on the front panel. This choice is independent of display status.

The Model 805 is direct reading in temperature when used with the Lake Shore DT-470 Series Temperature Sensors. All DT-470 Sensors follow the same temperature response curve. Four bands of tracking accuracy are offered so that sensor selection may be made with both technical and economical considerations for any given application. Low temperature (2 to 100K) accuracies range from 0.25K for band 11 to 1K for band 13. For more demanding requirements, DT-470 Sensors can be individually calibrated to accuracies of better than 50 millikelvin depending on temperature range.

Diode sensor voltages are digitized with a resolution of 100 microvolts out of 3 volts full scale. For the display, temperature is rounded to 0.1 kelvin above 100 kelvin, and to 0.01 kelvin below 100 kelvin.

For greater precision individual sensor calibrations can be accommodated through the 8001 Precision Calibration Option which programs the instrument with a particular response curve. The algorithm within the instrument interpolates between data points to an interpolation accuracy which exceeds 0.01K over the entire temperature range of the Precision Option. The analog-to-digital converter is accurate to plus or minus the least significant bit, which for the 470 series sensor results in an uncertainty of 1mK below 28K and 45mK above 40K with a transitional region between the two temperatures. Therefore, at temperatures below 28K, the overall system accuracy, the sum of the instrument accuracy (11mK) and that of the calibration itself (Lake Shore calibrations are typically better than 20mK within this region) is ±

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0.03K. Above 28K, system accuracy gradually moderates to a typical value of ±75mK above 40K. See the Lake Shore Cryotronics, Inc. Low Temperature Calibration Service brochure for additional discussion of calibration accuracy.

The 805 display uses digital filtering which averages up to ten temperature readings. This reading mode eliminates noise within the cryogenic system analogous to averaging with a digital voltmeter. This algorithm can be deselected (bypassed) by switch 2 of the SENSOR ID dip switch on the back panel for a given input if the user prefers not to average readings. A decimal point at the upper left of the display indicates that averaging is on.

The Model 805 can also be used with the optional input conversion modules (-6) which allow either input to be converted to handle either the TG-120 series diodes (or any diode with a 0 to 6 volt output), or positive temperature coefficient metallic resistors., i.e., platinum (-P2 or -P3) or rhodium-iron (-R1) resistors. The DIN curve is standard within the instrument and is called up automatically unless a precision option is present for the platinum resistor. The accuracy of the reading is dictated by the sensor and its conformity to the DIN curve. The tolerance on these devices is given on the technical data sheet for the Lake Shore PT-100 series sensors. The combined accuracy of the instrument and a calibrated resistor with a precision option is on the order of 40mK over the useful range of the sensor (above 40K for the platinum). Note that a precision option is required for a rhodium-iron or a TG-120 to read correctly in temperature.

These input conversion modules are easily installed by the user; thus, units can be modified to satisfy changing requirements.

The ample memory space provided in the 805 allows several response curves to be stored in one instrument. Depending on the complexity of the curves, up to ten can be programmed into the unit by Lake Shore. The SENSOR ID switches are used to select which particular sensor response curve is to be used with each input. Thus, the user is able to make sensor changes at will even when different response curves are required.

The data for calibrated sensors can be stored within the instrument by means of the 8001 Precision Option. Each curve can contain up to 99 sensor unit-temperature data points. With the standard precision option format, which consists of 31 data points and a 20 character information line, up to ten curves can be stored in the unit. See Section 3-3 for more description.

Although voltage (resistance)-temperature data points are stored as a table, interpolation within the instrument results in the equivalent of a high order polynomial calculation in the converting of the input voltage (or resistance) to temperature. This is done by means of a proprietary algorithm developed at Lake Shore Cryotronics, Inc.

The control temperature set-point selection is made via thumbwheel switches on the front panel of the instrument. The set-point switches, which provide a continuous indication of the set-point value, enable the user to quickly and easily determine whether his system is at control temperature. The set-point is in the same units as is the Display sensor (kelvin, celsius, fahrenheit, or volts [ohms]).

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The control section of the 805 provides two-term temperature control. Proportional (GAIN) and integral (RESET) are individually tuned via front-panel potentiometers. The gain and reset settings are in nominal log per cent.

Analog heater output of the 805 Temperature Controller is a maximum of 25 watts when a 25 ohm heater is used. A digital meter on the front panel of the 805 continuously shows the heater power output as a percentage of output range. Thus, the user can conveniently monitor power applied to his system. To accommodate systems which require lower heater power, the maximum heater output of the 805 can be attenuated in two steps of a decade each. When greater power output is required, an optional 60 watt power output stage is available (W60) which is designed for a 25 ohm load. It is rated at a nominal 1.5 amperes with a compliance of 43 volts.

An optional IEEE-488 (Model 8054) or RS-232C (Model 8053) interface is available for the 805. Either interface can be used to remotely control all front-panel functions.

1.3 INPUT CONVERSION MODULES

The input conversion modules for the 805 Controller are listed in Table 1-1.

1.4 SPECIFICATIONS

Instrument specifications are listed in Table 1-2. These specifications are the performance standards or limits against which the instrument is tested.

Option ports are designed into the 805 to ease the addition of interfaces and outputs. The Model 805 has two option ports which allow up to two options to be used simultaneously (see limitations below). The options are easily installed by the user; thus, units can be changed or upgraded to satisfy changing requirements.

Only one computer interface can be installed in the 805 due to space limitations in the 805 rear-panel. The Model 8055 Analog Output option is available to provide an analog output of 10mV/K independent of the display temperature units. If the display is in sensor units, the output for diodes is 1V/V; for 100 ohm platinum, 10mV/ohm; for 1000 ohm platinum, 1mV/ohm; for rhodium-iron, 100mv/ohm.

Table 1-1. Input Conversion Modules, Model 805 Temperature Controller

Diode or Resistance Sensor (ordered separately):

DIODE SENSOR CONFIGURATION

Diode Excitation: DC current Source. 10 microamperes (±0.005%). AC noise from current source less than 0.01% of DC current.

Diode Voltage/Temperature Range: 0.000 to 3.000 volts in standard configuration. Dependent on Sensor selected. DT-470-SD covers temperature range from 1.4 to 475 kelvin. Refer to Table 3-2 for other diode temperature limitations.

Display Resolution: 1mV or up to four digits and resolution of 0.01 units in temperature.

Diode Response Curve(s): The silicon diode series DT-470 Curve #10 as well as the series DT-500 DRC-D and DRC-E curves are present in the 805. Curves to match other existing Sensors are available on request.

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Diode Sensor Power Dissipation: Dissipation is the product of Sensor Excitation Current 10uA) and Resultant Sensor Voltage.

Accuracy: Unit reads sensor voltage to an accuracy of better than 0.1mV. Equivalent temperature accuracy is a function of Sensor type, temperature (sensitivity) and calibration of Sensor. See the Technical Data Sheet for the DT-470 Series Temperature Sensors and the Model 8001 Precision Option for accuracy with LSCI calibrated Sensors.

6-VOLT DIODE SENSOR MODULE

805-6 Diode Sensor Input Module. Similar to standard configuration but has 0 to 6 volt input to accommodate TG-120 Series Sensors. Converts either Input A or Input B (or both with two modules) to accommodate the 6 volt modification for TG-120 series sensors. Requires calibrated sensor and 8001 Precision Option for 805 to read correctly in temperature. This module may be field installed.

100 OHM PLATINUM MODULE

805-P2 100 Ohm Platinum Sensor Module: Converts either Input A or B (or both with two modules) to accommodate 100 ohm Platinum RTD Sensors. This module may be field installed.

Sensor Excitation: 1.0 mA (±0.005%).

Temperature/Resistance Range: Temperature range depends on Sensor. Resistance displayed from 0.0 to 300.0 ohms.

Resolution: 0.01 ohm or equivalent temperature.

Sensor (order separately): Configuration optimized for PT100 Series Platinum Sensors or any other 100 ohm (at 0°C) positive temperature coefficient Sensor.

Sensor Response Curve: Platinum Sensor response curve is based on 0.1% interchangeability at 0°C and temperature coefficient (0-100°C) of 0.00385/°C. Accuracy conforms to DIN 43760 tolerances plus display (electronics). Special calibrations can be accommodated with 8001 Precision Option.

Sensor Power Dissipation: Dissipation is the product of sensor excitation current squared and the Sensor resistance.

1000 OHM PLATINUM MODULE

805-P3 1000 Ohm Platinum Sensor Module: Essentially the same as the -P2 except accommodates 1000 ohm Platinum Sensor (or any other 1000 ohm metallic sensor). Sensor excitation is 0.1 milliampere. Unit reads resistance in ohms and displays 0. to 3000 ohms. Accuracy is 0.1 ohm or equivalent temperature.

27 OHM RHODIUM-IRON MODULE

805-R1 27-ohm Rhodium-Iron Sensor Module: Essentially the same as-P2 except accommodates RF-800-4 Rhodium-Iron Sensor. Sensor excitation is 1mA. Unit reads resistance in ohms and displays 0.00 to 99.99 ohms. Requires calibrated sensor and programmed calibration to read temperature. Accuracy and resolution is 0.003 ohms or equivalent temperature.

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Table 1-2. Specifications, Model 805 Temperature Controller

INPUT CHARACTERISTICS:

Inputs: Two Sensor Inputs. Control Sensor (A or B) selected via rear panel switch and indicated on the front panel. Display sensor (A or B) can be selected from front panel or interface, independent of control sensor. The input characteristics are a function of Input Conversion Module Installed. The 805 can accommodate separate input modules for the A and B input. This allows concurrent use of different sensor types.

Input Conversion Modules: Standard configuration for the 805 is both inputs set up to use DT-470 series silicon diode sensors (0-3V). Optional input conversion modules allow the 805 to be used with TG-120 series diode sensors (0-6V), as well as PT-100 series 100/1000 ohm platinum RTD's, and RF-800 series rhodium-iron sensors.

Input Conversion Module Sensor Type (one per input)

-6*	6 volt diodes (e.g. TG-120)
-P2	100 ohm Platinum
-P3*	1000 ohm Platinum
-R1*	27 ohm rhodium-iron

* To read correctly in a temperature scale,these modules require the use of calibrated sensors and the 8001 Precision option for the 805.

Sensors: Ordered Separately. 805 with input conversion modules will handle all types of diodes as well as platinum and rhodium-iron RTD's and other positive temperature coefficient resistors with proper choice of input. See the Lake Shore Cryotronics, Inc. Sensor catalog for details on the above Sensors.

Sensor Response Selection: Rear-panel Dip switch or Interface permits selection of appropriate Sensor response curve when more than one curve is stored (see Precision Option).

DISPLAY READOUT:

Display: 4-digit LED Display of Sensor reading in Sensor Units (Volts or Ohms) or temperature in K, ^{o}C, or ^{o}F shown with annunciators.

Display Resolution: 0.1K above 100K, 0.01K below 100K; voltage for diodes to 1 mV and ohms for resistors to four places.

Temperature Accuracy: Dependent on Sensor Input and Sensor. See Input Options available.

Temperature Range: Dependent on Input Conversion Module and Sensor.

TEMPERATURE CONTROL:

Set Point: Digital thumbwheel selection in kelvin, celsius, fahrenheit, or volts (ohms with resistance option).

Set Point Resolution: Same units as display.

In voltage: 0.000 to 9.999 volts.

In ohms:

805-P2:	0.0	to	999.9 ohms.
805-P3:	0.0	to	9999 ohms.
805-R1:	0.0	to	99.9 ohms.

Controllability: Typically better than 0.1K in a properly designed system.

Control Modes: Proportional (gain) and integral (reset) set via front-panel or with optional computer interface.

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Heater output: Up to 25 watts (1A,25V) available. Three output ranges can be selected either from front-panel or from optional computer interface and provide approximate decade step reductions of maximum power output. Optional 60 watt, 1.5 ampere 25 ohm output (Option W60) is available for the 805 only as a factory installed option.

Heater output Monitor: LED display continuously shows heater output as a percentage of output range with a resolution of 1%.

Control Sensor: Either Sensor Input (selected from rear panel).

GENERAL:

Sensor Voltage Monitor: Buffered output of each diode sensor voltage for standard configuration. For -6 option module, voltage output times 0.455. For positive temperature coefficient modules (-P2, -P3, -R1), buffer is sensor voltage output times (-10).

Response time (electronics): Display update cycle time of less than 1 second (650 msec typical). 2 seconds (3 readings) on channel change or step change.

IEEE-488 Interface Option: Allows remote control of setpoint, gain, reset, units, display sensor and heater power range. Provides output of display, display units and all front panel functions.

RS-232C Interface Option: Controls same parameters as IEEE-488 Interface.

Dimensions, Weight: 216mm wide x 102mm high x 381mm deep (8.5in. x 4in. x 15in.), 5.5 kilograms (12 pounds).

Power: 100, 120, 220 or 240 VAC (selected via rear panel with instrument off), 50 or 60 Hz, 75 watts.

Accessories Supplied: Mating connector for sensor/monitor connector, operations manual.

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SECTION II

INSTALLATION

2.1 INTRODUCTION

This Section contains information and instructions pertaining to instrument set-up. Included are inspection procedures, power and grounding requirements, environmental information, bench and rack mounting instructions, a description of interface connectors, and repackaging instructions.

2.2 INITIAL INSPECTION

This instrument was electrically, mechanically and functionally inspected prior to shipment. It should be free from mechanical damage, and in perfect working order upon receipt. To confirm this, the instrument should be visually inspected for damage and tested electrically to detect any concealed damage upon receipt. Be sure to inventory all components supplied before discarding any shipping materials. If there is damage to the instrument in transit, be sure to file appropriate claims promptly with the carrier, and/or insurance company. Please advise Lake Shore Cryotronics, Inc. of such filings. In case of parts shortages, advise LSCI immediately. LSCI can not be responsible for any missing parts unless notified within 30 days of shipment. The standard Lake Shore Cryotronics Warranty is given on the first page of this manual.

2.3 PREPARATION FOR USE

2.3.1 Power Requirements

The Model 805 requires a power source of 100, 120, 220 or 240 VAC (+5%, -10%), 50 to 60 Hz single phase.

CAUTION

Verify that the AC Line Voltage Selection Wheel (Figure 3-2,Key 1) located on the rear panel of the Model 805 is set to the AC voltage to be used (Table 2-1) and that the proper fuse is installed before inserting the power cord and turning on the instrument. If a W60 option is present, the fuse ratings in Table 2-1 double.

2.3.2 Power Cord

A three-prong detachable 120 VAC power cord which mates with the rear panel UL/IEC/ICEE Standard plug is included with 805.

2.3.3 Grounding Requirements

To protect operating personnel, the National Electrical Manufacturer's Association (NEMA) recommends, and some local codes require, instrument cabinets to be grounded. This instrument is equipped with a three-conductor power cable which, when plugged into an appropriate receptacle, grounds the instrument.

Table 2-1. Line Voltage Selection

Line Voltage (Volts)	Operating Range (Volts)	Fuse (A)
100	90-105	2 - SB
120	108-126	2 - SB
220	198-231	1 - SB
240	216-252	1 - SB

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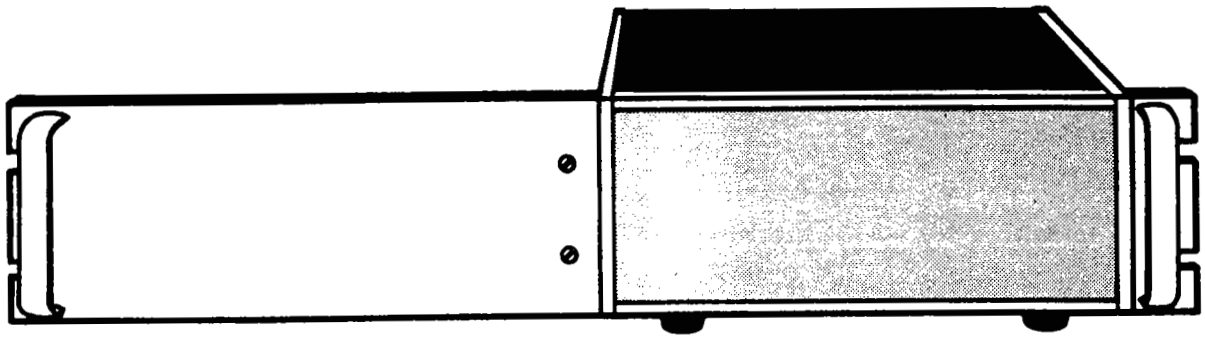
Figure 2-1. Typical Rack Configuration



2.3.4 Bench Use

The 805 is shipped with feet and a tilt stand installed and is ready for use as a bench instrument. The front of the instrument may be elevated for convenience of operation and viewing by extending the tilt stand.

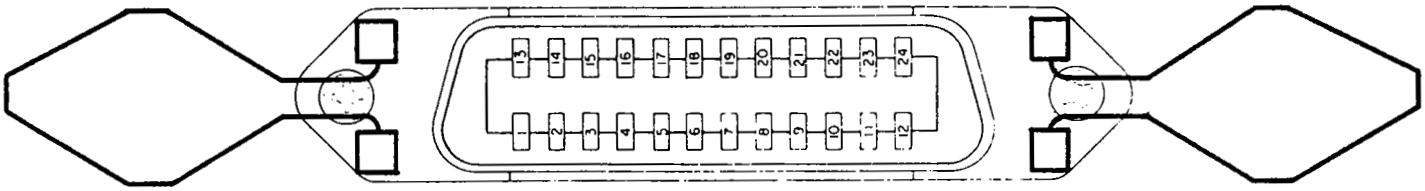
2.3.5 Rack Mounting

The 805 can be installed in a standard 19 inch instrument rack by using the optional RM-3H1 or RM-3H2 rack mounting kit. A typical RM-3H1 rack kit installations with handles is shown in Figure 2-1.

2.3.6 Sensor Input Connections

The Model 805 is supplied with a 24 pin rear panel mounted D-style connector for the connection of two sensors. The connection definition for the sensor(s) is given in Table 2-2 and is shown in Figure 2-2.

Table 2-2. J1 SENSORS/MONITORS Connections.



Pin #	Function	Pin #	Function
1	+V A Input	13	+I A Input
2	-V A Input	14	-I A Input
3	SHIELD (A Input)	15	SHIELD (B Input)
4	+V B Input	16	+I B Input
5	-V B Input	17	-I B Input
6	+V Buffered Sensor -	18	+V Option 8055
7	-V Output Signal(A)	19	-V Analog Output
8	+V Buffered Sensor -	20	+5 VDC (10 mA LIMITED)
9	-V Output Signal(B)	21	DIGITAL GROUND
10		22	
11		23	
12		24	

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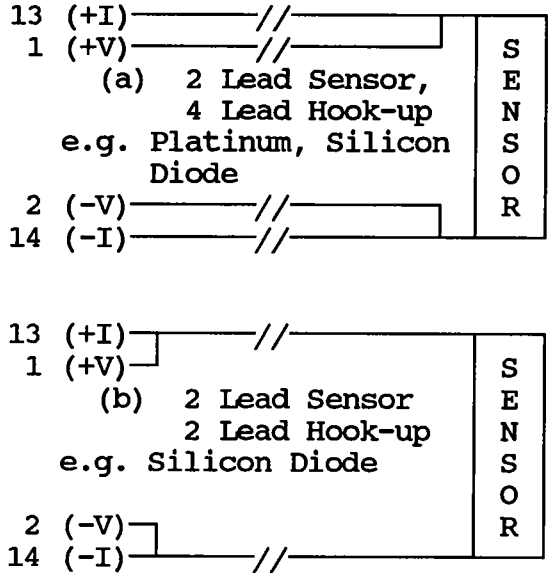
Figure 2-2. Sensor Connections.



The use of a four wire connection (Figure 2-2a) is highly recommended for resistive elements to avoid introducing IR drops in the voltage sensing pair which translates into a temperature measurement error. An alternate two line wiring method (Terminals 1 and 13 shorted to each other, 2 and 14 shorted to each other) may be used for the DT-470 and TG-120 series diodes in less critical applications where lead resistance is small and small read-out errors can be tolerated (b). Measurement errors due to lead resistance for a two lead diode hook-up can be calculated using; $\delta T = IR/[dV/dT]$ where I is the sensor current of 10 microamperes, R is the total lead resistance; dV/dT is the diode sensitivity and δT is the measurement error. For example, R = 250 ohms with dV/dT = 2.5 millivolts/kelvin results in a temperature error of 1 kelvin. Two wire connections are not recommended for other sensor types.

The Lake Shore Cryotronics, Inc. QL-36 QUAD-LEAD™ 36 gauge cryogenic wire is ideal for connections to the sensor since the four leads are run together and color coded. The wire is phosphor Bronze with a formvar insulation and butryral bonding between the four leads.

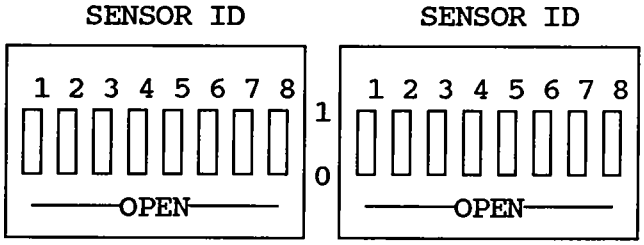
2.3.7 Sensor Output Monitors

Voltage monitor outputs of both Sensor A and Sensor B are available from the same connector on the back of the instrument. This connector also carries the Model 8055 Analog Output Option when present. The connector pin definitions are given in Table 2-2.

2.3.8 SENSOR ID Switches

The SENSOR A ID and SENSOR B ID switches are used to select stored sensor curves and to activate or deactivate digital filtering. The SENSOR ID switch information is described in Table 2-3 and Figure 2-3.

Figure 2-3. SENSOR ID Definitions



Switch	Setting Description
1	Reserved
2	OPEN - Continuous Update CLOSED - Digital Filter On
3	Reserved
4	Reserved
5	Curve Bit 3
6	Curve Bit 2
7	Curve Bit 1
8	Curve Bit 0

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Table 2-3 gives the position of the ID switches to call up standard curves stored in the instrument. Information on Precision Option Curves is given in Appendix B.

Curve #2 and Curve #4 differ in that Curve #2 has an upper temperature limit of 325K which limits the set point between 0 and 325K while Curve #4 has an upper limit of 475K and a corresponding upper limit for the set point.

Table 2-3. SENSOR ID Curve Address

SENSOR ID Switch 4	5	6	7	8	Curve #	Description
0	0	0	0	0	00	DRC-D
0	0	0	0	1	01	DRC-E1
0	0	0	1	0	02	CRV 10
0	0	0	1	1	03	DIN-PT
0	0	1	0	0	04	CRV 10

Refer to SECTION III for more information on sensor selection and the operation of the SENSOR ID switches.

2.3.9 Heater Power

The heater output leads should be electrically isolated from the sensor(s) ground(s) to preclude the possibility of any of the heater current affecting the sensor input signal. The heater leads should not run coincident with the sensor leads due to the possibility of capacitive pick-up between the two sets of leads. If they are in close proximity, they should be wound so as to cross the sensor leads at ninety degrees if at all possible.

The heater output is a current drive and does not have to be fused. The 805 is designed to work with a 25 ohm heater for maximum heater output (25 watts). If a smaller resistance is used, the maximum heater power corresponds to the heater resistance, i.e., 10 ohms yields 10 watts. A larger heater resistance can also be used with the 805. For example, since the compliance voltage is slightly above 25 volts; a 50 ohm heater would result in a maximum power output of 12.5 watts $[(25)^2/50]$. An optional (W60) output power stage of 60 watts is available for the 805. This output is also set up for a 25 ohm load with a maximum current of 1.5 amperes at a compliance voltage of approximately 43 volts.

Lake Shore recommends a 30 gauge stranded copper lead wire (Model ND-30) for use as lead wires to the heater.

2.4 OPTIONS

2.4.1 Model 8053 RS-232C INTERFACE Option. The RS-232C option is described in Section VI of this manual.

2.4.2 Model 8054 IEEE-488 INTERFACE Option. The IEEE option is described in Section VI of this manual.

2.4.3 Model 8055 Linear Analog Output Option. The Linear Analog Option is described in Section VI of this Manual.

2.5 ENVIRONMENTAL REQUIREMENTS

WARNING

To prevent electrical fire or shock hazards, do not expose the instrument to excess moisture.

2.5.1 Operating Temperature

In order to meet and maintain the specifications in Table 1-1, the 805 should be operated at an ambient temperature range of 23°C ± 5°C. The unit may be operated within the range of 15-35°C with less accuracy.

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2.5.2 Humidity/Altitude

The 805 is for laboratory use. Relative humidity and altitude specifications have not been determined for this unit.

2.6 REPACKAGING FOR SHIPMENT

If the Model 805 appears to be operating incorrectly, refer to the Section V. If these tests indicate that there is a fault with the instrument, please contact LSCI or a factory representative for a returned Goods Authorization (RGA) number before returning the instrument to our service department.

When returning an instrument for service, photocopy and complete the Service Form found at the back of this manual. The form should include:

1. Instrument Model and Serial #s
2. User's Name, Company, Address, and Phone Number
3. Malfunction Symptoms
4. Description of System
5. Returned Goods Authorization #

If the original carton is available, repack the instrument in a plastic bag, place it in the carton using original spacers to protect protruding controls. Seal the carton with strong paper or nylon tape. Affix shipping labels and "FRAGILE" warnings.

If the original carton is not available, pack the instrument similar to the above procedure, being careful to use spacers or suitable packing material on all sides of the instrument.

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SECTION III

OPERATING INSTRUCTIONS

3.1 INTRODUCTION

This section contains information and instructions concerning the operation of the Model 805 Temperature Controller. Included is a description of the front and rear panel controls and indicators.

3.2 INSTRUMENT CONFIGURATION

3.2.1 Input Modules

The Model 805 can be used with several different input modules. These modules are summarized in Section I. Input modules can be mixed, allowing two different sensor types to be used with the 805, e.g., both a diode and a resistance thermometer could be used on the two inputs, with the addition of one optional input module.

3.3 PRECISION OPTIONS

There are two types of Precision Options available for the 805. The 8001 Precision Option is supplied for calibrated sensor(s) precision option data ordered at the same time as the 805.

The 8002 Precision Option is used when the customer already owns an 805 and wants new sensor calibration data stored in the instrument. LSCI stores the calibration data in an IC chip and sends the programmed chip to the customer. The IC is then installed in the 805 by the customer. Note: When ordering the 8002 Precision Option, specify the serial number of the 805.

Note that additional calibrations can be added to the instrument at a later time by specifying with the sensor calibration at time of order, the serial number of the instrument the sensor will be used with.

If a Precision Option is ordered from the factory, its curve number will be specified for the user and included in the manual as an addenda to the manual (see Section 3.13.2 and Table 3-3).

Note: A proprietary algorithm is used to fit the precision option data to within a few millikelvin over the entire temperature range.

3.4 CONTROL FUNDAMENTALS

An application note entitled "Fundamentals for Usage of Cryogenic Temperature Controllers" is included as an appendix in this manual and should be read in detail if you are not familiar with cryogenic temperature controllers.

3.5 CONTROLS AND INDICATORS

Figures 3-1 and 3-2 identify the 805 displays, annunciators, controls, and connectors. The identification of each item is keyed in the appropriate figure.

FRONT PANEL DESCRIPTION

3.6 POWER ON/OFF Switch

Before connecting AC power to the 805, make sure the rear panel voltage selector is set to correspond to the available power line voltage. Be certain the correct fuse is installed in the instrument (Section 2.3.1).

3.6.1 POWER UP SEQUENCE

Immediately on POWER ON the 805 runs through a power up sequence as follows:

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1. The Display indicates ±8.8.8.8 and the Heater % indicates 188. In addition all annunciators and LED's are turned on. The LED's include: SENSOR A and B, CONTROL SENSOR A and B as well as four sets of units; HEATER POWER (LO, MED, HI); + and -; 2 decimal points for set point, an ohms indicator; and with an optional computer interface, the LOCAL/REMOTE indicators.

2. Next, the unit displays 805 in the display window and, if present, indicates the IEEE-488 interface address in the HEATER % window. This address can be changed by the user and verification is always given on power-up. Note that any changes in the IEEE-488 address are only recognized and read by the instrument on power-up.

3. The unit then displays for INPUT A the module associated with that input in the display window as well as the SENSOR A ID curve number in the HEATER % window.

4. The unit then displays the same information for Input B.

5. The unit then goes into normal operation.

3.7 DISPLAY SENSOR Block

3.7.1 DISPLAY SENSOR Input

The choice of Display SENSOR input is made by pushbuttons on the front panel which allows the user to display either input and indicate by an annunciator the sensor input which is currently displayed.

3.7.2 Units Select

The UNITS key is used to change the display and control units. The key is located below the lower right corner of the display window. Pressing the key scrolls the units, i.e., K °F V °C K etc. The selected units are displayed to the right of the HEATER % power display. The units display light is blinking to indicate the frequency of display update. If a resistance module is present, the ohms indicator comes on in place of V.

The temperature units for both inputs are selected by the units button and are kept the same to avoid confusion.

3.7.3 Display SENSOR Units

3.7.3.1 Voltage Units

In the voltage mode, the display has a resolution of 1 millivolt and a full scale input of 3.000 volts (6.553 volts for the -6 module). If an input exceeding 3.000V (or 6.553V for the -6 module) is applied to the displayed input, an overload condition is present and is indicated by an OL on the display.

3.7.3.2 Resistance Units

The Resistance mode requires the 805-P2, -P3, or -R1 input conversion module(s).

The display ranges and resolutions for the 805-P2, -P3 and -R1 are 0.0 to 299.9 ohms, 0 to 2999 and 0.00 to 99.99 ohms respectively. If a resistance exceeding full scale is applied to the input, OL is indicated on the display.

3.7.3.3 Temperature Units

In kelvin temperature units, the chosen input is displayed with a display resolution of 0.1 degree above 100 kelvin and 0.01 degree between 1 and 100 kelvin. Note that this is **display** resolution and **not** system resolution **or** accuracy of the reading. If the sensitivity of the sensor is too low to support this resolution, i.e., one bit

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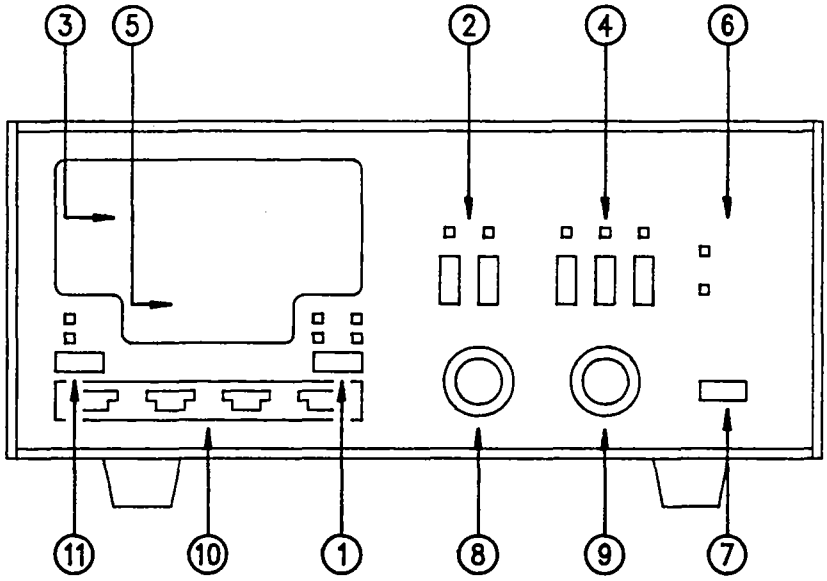
Figure 3-1. Model 805 Temperature Controller - Front Panel



1. Units selector button with annunciators in kelvin, celsius, fahrenheit or sensor units (volts or resistance).

2. Annunciated SENSOR Selector buttons (A or B) for display sensor.

3. Display sensor reading in units selected (see Key 1) with filter indication.

4. HEATER POWER full scale selector buttons with annunciators (LO = 10^{-2}, MED = 10^{-1}, HI = 10^{0}[or 1] times 25 watts).

5. Per cent power meter. Power out equals meter reading times range selection times 25 watts with 25 ohm heater.

6. CONTROL SENSOR annunciator (A or B) as selected on rear panel.

7. POWER ON-OFF switch.

8. Variable GAIN (proportional) control.

9. Variable RESET (integral) control with OFF detent.

10. Digital set point in selected units (see Key 1) with annunciators for decimal point.

11. Sign selector button for set point with + and - annunciators when selected units (see Key 1) are in celsius or fahrenheit and to toggle the LOCAL and REMOTE status of the unit.

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corresponds to greater than the above resolution, some temperatures may be skipped. This will be true for a silicon diode sensor between 30 kelvin and 100 kelvin where the sensitivity is approximately 2.5 millivolts per kelvin and the voltage resolution is 0.046 millivolts. For this case, the resulting temperature resolution is 0.046/2.5 = 0.018 kelvin. However, below 30 kelvin the silicon diode sensitivity is approximately 25 millivolts per kelvin which results in an approximate resolution of 0.002 kelvin (0.046/25).

For the celsius and fahrenheit scales, resolution is 0.01 degree within 100 degrees of their respective zeros and 0.1 degree outside this band for either positive or negative temperatures.

3.7.4 Filtering the Display

An averaging algorithm within the instrument is available which averages up to ten readings. This reading mode eliminates noise within the cryogenic system analogous to averaging within a digital voltmeter. This function can be selected or deselected by switch 2 of the SENSOR ID on the back panel for each input separately. The 805 is shipped from the factory with the filtering function selected.

The decimal point on the sign digit at the far left of the display window flags "Filter-on" and will indicate whether the averaging algorithm is being used.

If the averaging algorithm is used, displayed temperature is on the average of somewhere between 1 and ten readings depending on the temperature variation. If an abrupt change in temperature is observed, averaging is disabled and the last calculated reading is displayed. As the disturbance is reduced in value, the averaging gradually increases until a total of ten readings are considered.

3.8 CONTROL BLOCK

3.8.1 CONTROL SENSOR

The choice of input for the CONTROL SENSOR is made by a switch labeled CONTROL on the rear panel. This switch selects either INPUT A or INPUT B for control and lights the appropriate display light on the front panel.

3.8.2 SET POINT

Set point selection is made via thumbwheel switches on the front panel. The set point switches, which provide a continuous indication of the set point value when the unit is in LOCAL mode, enable the user to quickly and easily determine whether the test system is at the control temperature.

The temperature set point has the same units as the display sensor. The selected units are annunciated on the front panel. The set point limits are determined by the sensor curve being used for the control sensor input.

If a selected temperature set point is outside of the control sensor's response curve temperature range, the set point is set in software equivalent to 0 K which shuts down the heater output stage and the output meter reads 0 and blinks to indicate an out of range set point. The resistance limit ranges are given in Section 3.7.3.2. If a resistance set point above the appropriate resistance limit in ohms is set, the set point is set in software equivalent to zero resistance (0 K equivalent) which shuts down the output stage.

The ± key is used to toggle the set point plus or minus when in °C or °F only. The ± key is inactive

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when in K, V or R since these units are always positive. With a remote interface present, holding in the ± button for over one second results in a REMOTE/LOCAL toggle.

3.8.3 GAIN

The GAIN (proportional) knob allows adjustment of overall controller gain in the range of 1 to 1000. Maximum gain is full clockwise. Logarithmic scaling is used; therefore a gain setting of x100 is approximately two-thirds of full rotation. Refer to Figure 3-3a for nominal values.

3.8.4 RESET

The RESET knob adjusts the reset (integral) function of the controller in seconds. The settings range from 990 to 1 second (full clockwise) on a logarithmic scale. Detented counterclockwise setting is off. Refer to Figure 3-3b and Table 3-1 for nominal values.

Table 3-1. Reset Settings

SETTING-LOG %	TIME(SEC)
0.0 (OFF)	∞
0.1 (10^{-1})	990
0.5	300
1.0 (10^{0})	100
5.0	30
10 (10^{1})	10
50	3
100 (10^{2})	1

3.8.5 HEATER %

The HEATER % display can be set to read in per cent of power $[I/I_{max}]^2$ or percent of maximum current by the position of switch #1 of the internal configuration dip switch package S4 which is located on the main board. The instrument is shipped from the factory with switch one of S4 off which results in the display reading in per cent power.

The HEATER % display is located directly below the sensor display. It displays the magnitude of the heater power or current in per cent of full scale (0% - 100%). Full scale in power is defined as the product of the load resistance times the HEATER POWER range setting.

3.8.6 HEATER POWER Range

The HEATER POWER setting is determined by the switches on the front panel labeled HEATER POWER. HI corresponds to 10^{0} or 1 while MED and LO correspond to 10^{-1} and 10^{-2}, respectively. Full scale in current is either 1 ampere, 300 milliamperes or 100 milliamperes which correspond to the HEATER POWER range settings of HI, MED or LO respectively.

The power output stage can be turned OFF by depressing the LO, MED or HI button whose annunciator is on. This action turns off the output power independent of the set-point and the control parameters.

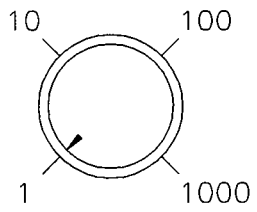
3.9 LOCAL/REMOTE SELECTION

If either the IEEE-488 option or the RS-232C option is present in the 805, pressing the SETPOINT ± BUTTON for greater than 1 second toggles the 805 between REMOTE and LOCAL operation.

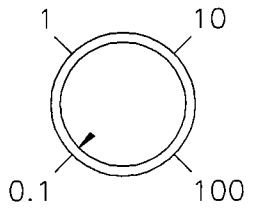
LOCAL indicates front-panel control. When returned to LOCAL, the display shows the curve number for the display SENSOR indicated.

When placed in REMOTE, the controller is under remote control and the front panel controls are disabled. The display shows the IEEE-488

Figure 3-3. Nominal Gain and Reset Settings



3-3a. Nominal Gain Settings



3-3b. Nominal Reset Settings

address when placed in remote if the ± key is held down for over one second. Refer to Section 4 for Remote Operation of the 805.

REAR PANEL DESCRIPTION.

3.10 CONTROL Switch

The CONTROL switch selects either the INPUT A or INPUT B signal to be fed to the control section of the 805. Since this selection is hard-wired through the switch, this choice can not be changed over either of the optional computer interfaces.

3.11 HEATER Power Output Terminals

The heater power output is rated at one ampere dc with a 25 volt compliance. The grey (HI) terminal is the high side and the black (LO) terminal is the low side. The black (GND) terminal is case ground and, if connected, should be tied to the LO terminal. It will normally not be used.

3.12 SENSORS/MONITORS

The connections for the J1 SENSORS/ MONITORS connector is given in Table 2-2.

3.13 SENSOR CURVE SELECTION

The 805 software interrogates the appropriate SENSOR ID switch (i.e., A or B) to determine which standard curve or Precision Option curve has been selected (Switches 5-8). The standard curves and their switch position are given in Table 3-2. The ID switch functions are defined in Figure 3-4.

Table 3-2. Standard Curve Information

Curve No.	Switch 5678	Temperature Range(K)	Curve Dscrptn
00	0000	1 - 324.9	DRC-D
01	0001	1 - 324.9	DRC-E1
02	0010	1 - 324.9	CRV 10
03	0011	14 - 799.9	DIN-PT
04	0100	1 - 474.9	CRV 10

Sixteen curves (00 through 15) can be selected from the SENSOR ID switches.

3.13.1 Display of Accessed Curve

To determine which curve that you are using is a simple matter for the 805. Select either the A or B input and depress and hold the Input key. After approximately one second, the display will show the following format:

A 02
d3

The above example indicates that no input module is installed in Input A and that the input is reading

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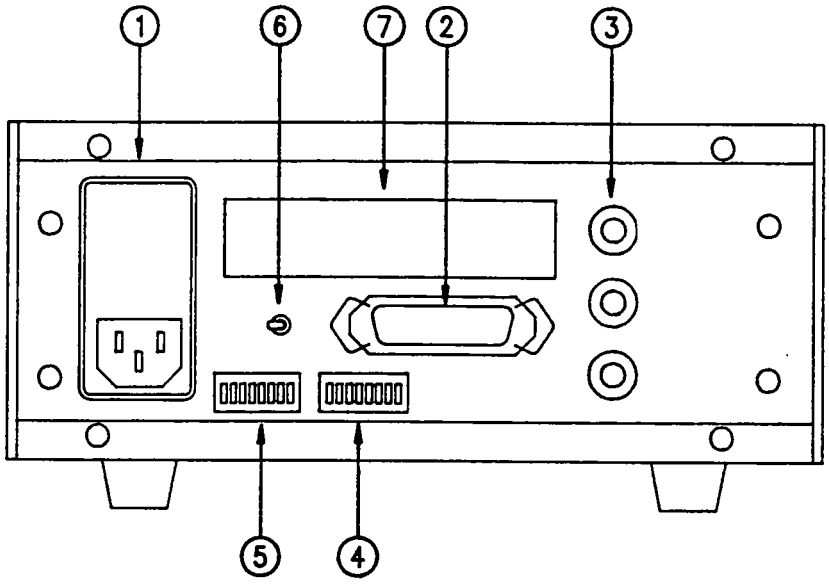
Curve 2, which from Table 3-2 we know is the CRV 10 for the DT-470 Series Sensors.

Since the 805 knows which type of input module is present for each input it will not, for example, allow the selection of the platinum curve (Curve No. 03) for a diode card. If Curve 03 is selected from the back panel SENSOR ID switch, the 805 will default to the lowest curve number with the correct temperature coefficient, in this case, curve 00. For the case of a platinum module and no Precision Option curves present, the 805 will select Curve Number 03, regardless of the settings for switches 5-8.

The input module and curve number for each input is also displayed on Power Up for a fraction of a second.

Figure 3-2. Model 805 Temperature Controller - Rear Panel



1. Line cord receptacle with fuse and voltage selection
2. J1 SENSORS/MONITORS input/output connector
3. HEATER power output terminals
4. SENSOR B ID
5. SENSOR A ID
6. Control Sensor Selector Switch
7. J2 Option Port for Model 8053 RS-232C Interface or Model 8054 IEEE-488 Interface.

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It is possible to store up to 16 curves total in the 805. These additional Precision Option Curves (10 possible), if present, can be accessed for each input through the SENSOR ID associated with each input.

3.13.2 The Precision Option Table

Table 3-3 gives the standard curves present in the 805 as well as any Precision Options which are factory installed including their address and the number of data points associated with each curve. This Table should be updated for the instrument if additional curves are added at a later time.

Up to 10 Precision Option Curves can be stored in the 805 with an average of 31 lines per curve. A Precision Option Curve can have up to 97 points with two additional end points automatically put into the table by the 805 software.

Note: For Lake Shore Precision Option Curves, a proprietary algorithm is used to fit the data to within a few millikelvin over the entire temperature range.

Table 3-3. Sensor Curve Information

Precision Option Table

Crve	# Line	Address	Description
00	31	1D40	DRC-D
01	31	1DF0	DRC-E1
02	31	1EA0	CRV 10
03	31	1F50	DIN-PT
04	31	2000	CRV 10
05	31	20B0	RESVRD
06			
07			
08			
09			
10			
11			
12			
13			
14			
15			

3.14 SENSOR ID Switches

The SENSOR ID switches select the appropriate standard curve or the Precision Option(s) curve stored in the instrument as well as activate or deactivate digital filtering. The switch information is described in Figure 2-3.

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S E C T I O N I V

R E M O T E O P E R A T I O N

4-1. IEEE-488 INTERFACE

The IEEE-488 INTERFACE is an instrumentation bus with hardware and programming standards designed to simplify instrument interfacing. The IEEE-488 INTERFACE of the Model 805 fully complies with the IEEE-488-1978 standard and incorporates the functional, electrical and mechanical specifications of the standard. It also follows the supplement to that standard titled "Code and Format Conventions for use with IEEE Standard 488-1978". This section contains general bus information, Model 805 interface capabilities, addressing and the programming instructions that control the Model 805 functions.

4.2 GENERAL IEEE SPECIFICATIONS AND OPERATION

The following discussion covers the general operation of the IEEE-488 interface. For a more detailed description of signal level and interaction, refer to the IEEE Standard 488-1978 publication "IEEE Standard Digital Interface for Programmable Instrumentation".

All instruments on the interface bus must be able to perform one or more of the interface functions of TALKER, LISTENER, or BUS CONTROLLER. A TALKER transmits data onto the bus to other devices. A LISTENER receives data from other devices through the bus. The BUS CONTROLLER designates to the devices on the bus which function to perform.

The Model 805 performs the functions of TALKER and LISTENER but cannot be a BUS CONTROLLER. The BUS CONTROLLER is your Digital Computer which tells the Model 805 which functions to perform.

The interface works on a party line basis with all devices on the bus connected in parallel. All the active circuitry of the bus is contained within the individual devices with the cable connecting all the devices in parallel to allow the transfer of data between all devices on the bus.

The following discussion of the signal lines on the bus are for general information. Your digital computer handles these lines through its circuitry and software. The user need never concern himself with these lines or signals, however, knowledge of their purpose will help one to understand the operation of the Interface.

There are 16 signal lines contained on the bus:

1. 8 Data Lines
2. 3 Transfer Control Lines
3. 5 General Interface Management Lines

The data lines consist of 8 signal lines that carry data in a bit parallel, byte serial format. These lines carry universal commands, addresses, program data, measurement data and status to all the devices on the bus.

The three Transfer Control lines and the five Interface Management lines are asserted low which means that they carry out their function when pulled low. When the voltage on one of these lines is high then the line is not asserted and the function is inhibited. The General Interface Management Lines IFC (Interface Clear), ATN (Attention), REN (Remote Enable), EOI (End or Identify) and the SRQ (Service request) manage the bus and control

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the orderly flow of commands on the bus. The IFC, ATN, and REN management lines are issued only by the BUS CONTROLLER.

The IFC (Interface Clear) management line is pulled low by the BUS CONTROLLER to clear the interface.

The ATN (Attention) line is the management line used by the BUS CONTROLLER to get the attention of the devices on the bus. The BUS CONTROLLER does this by pulling the ATN line low and sending talk or listen addresses on the DATA lines. When the ATN line is low, all devices listen to the DATA lines. When the ATN line goes high, then the devices addressed to send or receive data (for example, the Model 805) perform their functions while all others ignore the DATA lines.

The REN (Remote Enable) management line is pulled low by the BUS CONTROLLER to enable a device (the Model 805) to perform the functions of TALKER or LISTENER.

The EOI (End or Identify) management line is pulled low by the BUS CONTROLLER or a TALKER (the Model 805) to indicate the end of a multiple byte transfer sequence. Also the EOI line along with the ATN line are pulled low by the BUS CONTROLLER to execute a polling sequence.

The SRQ (Service Request) management line is pulled low by a device to signal the BUS CONTROLLER that a process is completed, a limit, overload or error encountered. In some cases this means that service is required. Transfer of the information on the data lines is accomplished through the use of the three signal lines: DAV (Data Valid), NRFD (Not Ready for Data) and NDAC (Not Data Accepted). Signals on these linesoperate in an interlocking hand-shake mode. The two signal lines, NRFD and NDAC, are each connected in a logical AND to all devices connected to the bus.

The DAV line is pulled low by the TALKER after it places its data on the DATA lines. This tells the LISTENERS that information on the DATA lines is valid. A LISTENER holds the NRFD line low to indicate it is not ready. Since these lines are connected in a logical AND to all other devices, then the NRFD line will not go high until all of the devices are ready.

The NDAC line is pulled low by a LISTENER while it is receiving the DATA and lets it go high when the DATA is captured. Since the NDAC lines of all devices are connected in a logical AND, the NDAC line will not go high until all devices have received the DATA.

4.3 INTERFACE CAPABILITIES

The IEEE-488 Interface capabilities of the Model 805 are listed in Table 4-1 as well as in mnemonic format on the instrument's rear panel.

Table 4-1. Interface Functions.

Mnemonic	Interface Function Name
SH1	Source Handshake Capability
AH1	Acceptor Handshake Capability
T7	Basic TALKER, no serial poll capability, Talk only,Unaddressed to Talk if addressed to Listen
L4	Basic LISTENER, Unaddressed to Listen if addressed to Talk
SR0	No Service Request capability
RL1	Complete Remote/Local capablty
PP0	No Parallel Poll capability
DC1	Full Device Clear capability
DT0	No Device Trigger capability
C0	No System Controller capablty
E1	Open Collector Electronics

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4.4 Model 805 IEEE-488 ADDRESS SWITCH

The IEEE-488 Address Switch is located on the instrument's rear panel (see Figure 3-2, Key No. 7). Refer to Figure 4-1 for the following discussion.

4.4.1 Terminating Characters (delimiters)

Switch 1 (*) is used to define the instrument's terminating characters (delimiters). The OPEN (0) position selects the ASCII characters CR and LF (Carriage Return and Line Feed) as the terminating characters for input and output data. For the output data from the Model 805 back to the computer over the Bus, the EOI line is set by the Model 805 with the output of the Line Feed (LF). This setting (0) for switch 1 is the setting for all Hewlett-Packard computers.

When Switch 1 (*) is CLOSED (1), a variable terminating character format may be selected for the input and output data. In this configuration the power-up (default) terminating characters are LF and CR with the EOI line being set with the output of the Carriage Return (CR). However, the two terminating characters can be changed via input data to the Model 805 as detailed in Table 4-6. If the terminating characters are changed by the user, these are only in effect until the instrument is turned off.

4.4.2 TALKER and/or LISTENER Configuration

Since the Model 805 is both a TALKER and a LISTENER, normally switches two and three should both be OPEN (0). These switches are usually of use when one instrument is a TALKER and another instrument is a LISTENER and they are to share the same address.

Figure 4-1. IEEE-488 Address Switch for the Model 805

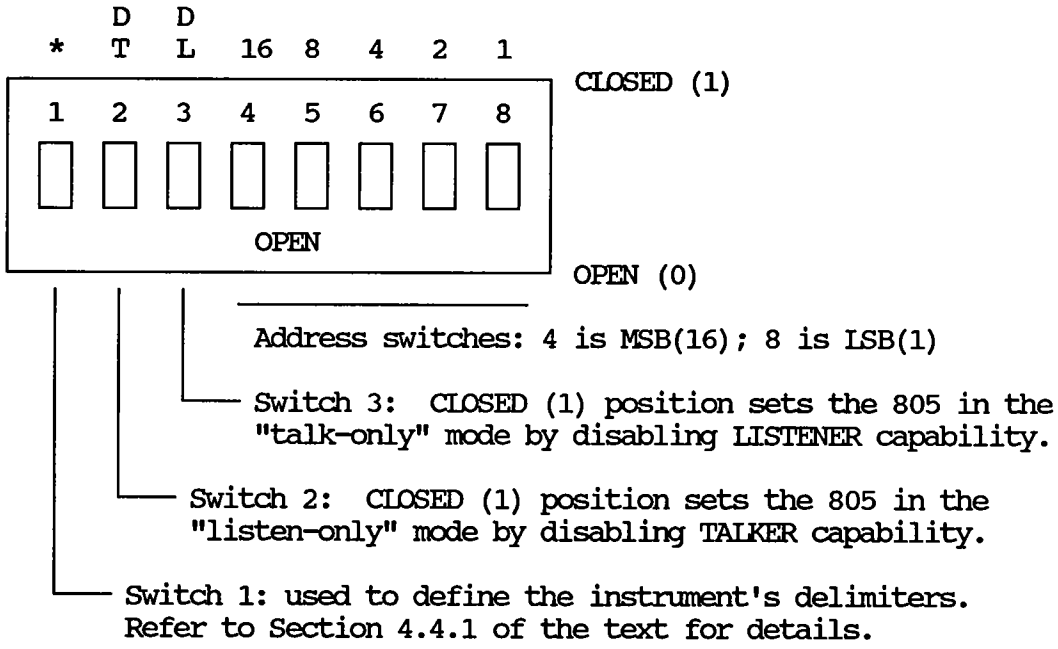
* DT DL 16 8 4 2 1
CLOSED (1)
1 2 3 4 5 6 7 8
OPEN
OPEN (0)
Address switches: 4 is MSB(16); 8 is LSB(1)
Switch 3: CLOSED (1) position sets the 805 in the "talk-only" mode by disabling LISTENER capability.
Switch 2: CLOSED (1) position sets the 805 in the "listen-only" mode by disabling TALKER capability.
Switch 1: used to define the instrument's delimiters. Refer to Section 4.4.1 of the text for details.

Table 4-2. Allowable Address Codes for the Model 805 (Factory preset address is decimal 12)

ASCII Code Character		Bit 2*	3	Address Switches 4	5	6	7	8	5-bit Decimal Code	
Listen	Talk	B7	B6	B5	B4	B3	B2	B1		
SP	@	0	0	0	0	0	0	0	00	
!	A	0	0	0	0	0	0	1	01	
"	B	0	0	0	0	0	1	0	02	
#	C	0	0	0	0	0	1	1	03	
$	D	0	0	0	0	1	0	0	04	
%	E	0	0	0	0	1	0	1	05	
&	F	0	0	0	0	1	1	0	06	Factory preset address
'	G	0	0	0	0	1	1	1	07	
(	H	0	0	0	1	0	0	0	08	
)	I	0	0	0	1	0	0	1	09	
*	J	0	0	0	1	0	1	0	10	
+	K	0	0	0	1	0	1	1	11	
,	L	0	0	0	1	1	0	0	12	
-	M	0	0	0	1	1	0	1	13	
.	N	0	0	0	1	1	1	0	14	
/	O	0	0	0	1	1	1	1	15	
0	P	0	0	1	0	0	0	0	16	
1	Q	0	0	1	0	0	0	1	17	
2	R	0	0	1	0	0	1	0	18	
3	S	0	0	1	0	0	1	1	19	
4	T	0	0	1	0	1	0	0	20	
5	U	0	0	1	0	1	0	1	21	
6	V	0	0	1	0	1	1	0	22	
7	W	0	0	1	0	1	1	1	23	
8	X	0	0	1	1	0	0	0	24	
9	Y	0	0	1	1	0	0	1	25	
:	Z	0	0	1	1	0	1	0	26	
;	[	0	0	1	1	0	1	1	27	
<	\	0	0	1	1	1	0	0	28	
=	]	0	0	1	1	1	0	1	29	
>	~	0	0	1	1	1	1	0	30	

* Only the first five bits of the binary code are listed. These bits are the same for the TALK and LISTEN address. The sixth and seventh bits (BUS CONTROLLER originated) determine whether the instrument is being addressed to TALK or LISTEN.

Function	Bit 2	3
TALK	1	0
LISTEN	0	1

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4.4.3 The IEEE-488 INTERFACE bus address for the Model 805 is set by switches 4 through 8 which are reserved for the address selection. Switch 4 is the most significant bit (MSB[=16]) and 8 is the least significant bit (LSB[=1]).

The factory preset address of this instrument is 12 (see Table 4-2). Address switch numbers 5 and 6 should be CLOSED (1) which will result in the Address Switch having a setting of 00001100 or 10001100 dependent on the requirements for the delimiters.

4.5 IEEE-488 BUS COMMANDS

4.5.1 A Uniline Command

A Uniline Command (Message) is a command which results in a single signal line being asserted. The Model 805 recognizes two of these messages from the BUS CONTROLLER, REN and IFC (See Table 4-3). When the BUS CONTROLLER executes the appropriate software code the effect is to pull the corresponding Interface Management line low. For example, when the software command REMOTE712 is executed by the HP86 digital computer, the management line REN is pulled low and the listen address 12 issued to signal the instrument having address 12 (805) to go into the remote mode.

4.5.2 The Universal Commands shown in Table 4-3 are those multiline commands that address all devices on the bus. A multiline command involve a group of signal lines. All devices equipped to implement such commands will do so simultaneously when the command is transmitted. As with all multiline commands, these commands are transmitted with ATN line asserted (low). There are two Universal commands recognized by the Model 805, LLO (Local Lockout) and DCL (Device Clear).

LLO (Local LOckout)-LLO is sent to instruments to lock out (prevent the use of) their front panel controls.

DCL (Device CLear)-DCL is used to return the Model 805 to the power-up conditions.

Table 4-3. IEEE-488 Bus Commands

Message Mnemonic	HP9825A Command	HP86 Command	IEEE-488 Bus Format
Uniline Commands			
Remote/REN	rem712	REMOTE712	?U*
Interface Clear/IFC			(IFC)
Universal Commands			
Local Lock Out/LLO	llo7	LOCAL LOCKOUT 7	?U(LLO)
Device Clear/DCL	clr7	CLEAR7	?U(DCL)
Addressed Commands			
Selected Device Clear/SDC	clr712	CLEAR712	?U,(SDC)
Go to Local/GTL	lcl712	LOCAL712	?U,(GTL)
Unaddress Commands			
Unlisten/UNL			?
Untalk/UNT			-

* U is the controller (computer) Talk Address (Address 21)

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4.5.3 The Addressed Commands shown in Table 4-3 are multiline commands that must include the Model 805 listen address before it will respond to the command in question. Note that only the addressed device will respond to these commands. The Model 805 recognizes two of the Addressed commands; SDC (Selective Device Clear) and GTL (Go To Local).

SDC (Selective Device Clear)-The SDC command performs essentially the same function as the DCL command except that only the addressed device responds. Generally, instruments return to their power-up default conditions when responding to the SDC command.

GTL (Go To Local)-The GTL command is used to remove instruments from the remote mode. With some instruments, GTL also unlocks front panel controls if they were previously locked out with the LLO command.

4.5.4 The Unaddress Commands

The Unaddress Commands in Table 4-3 are used by the BUS CONTROLLER to remove any TALKERS or LISTENERS from the bus. The ATN line is asserted (low) when these commands are asserted.

UNL (Unlisten) - LISTENERS are placed in the listener idle state by the UNL command.

UNT (Untalk) - Previous TALKERS will be placed in the TALKER idle state by the UNT command.

Table 4-3 summarizes the IEEE-488 Bus Commands acknowledged by the Model 805.

4.5.5 Device-Dependent Commands

The Model 805 supports a variety of device-dependent commands to allow the user to program the instrument remotely from a digital computer and to transfer measurements to the computer. These commands are sent from the computer (BUS CONTROLLER) to the Model 805 as one or more ASCII characters that tell the device to perform a specific function. For example, the command sequence F0K sent by the BUS CONTROLLER to the Model 805 is used to select kelvin as the set point units. The IEEE-488 bus actually treats these commands as data in that ATN is high when these device-dependent commands are transmitted.

4.5.6 TALKER and LISTENER Status

For the Model 805 to be a LISTENER, it has to be in REMOTE and can be returned to LOCAL with the M0 (device-dependent) command or GTL (addressed) command as desired. For most, but not all computers, the Model 805 as a TALKER does not have to be placed in REMOTE operation, but can remain under LOCAL control. This allows the user to collect data while maintaining front panel control. The HP computers will allow this mode of operation. If your computer automatically places the Model 805 in remote and keeps it in remote after the transmission is over, sending the additional command M0 after the request for data will return the Model 805 to LOCAL.

4.6 PROGRAMMING INSTRUCTIONS

The following discussion references the Modle 805 at address 12. The allowable address codes are given in Table 4-2. Therefore, its Talk ASCII Code is "L" and its LISTENER ASCII Code is "," (comma). The controller referred to in the following discussion is the BUS CONTROLLER and is normally a digital computer. It should not be confused with the temperature controller on the bus (Model 805). Set the IEEE Address of the Model 805 to 12 by making Switches 5 and 6 CLOSED (1), 4, 7 and 8 (OPEN) (0) and make sure Switch 1 is OPEN (0) to select (CR)(LF) as the terminating charac-

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ters. Note that this should be done prior to turning on the instrument since the Model 805 updates the IEEE address on power-up only. Confirm that the address selected is correct by holding in the +/- button for longer than one second and observe the IEEE address on the front panel display as follows:

-805-
12

4.6.1 Commands and Requests

The device-dependent commands to program the Model 805 are given in Table 4-4. The 805 must be addressed as a "LISTENER" to receive any instruction or string of instructions from the Command list.

The Model 805 input data format does not require a set number or set sequence of Commands to implement proper instrument set-up. These Commands are processed only after the terminators [TERM1][TERM2] are sent across the bus. The listing and explanation of the 805 commands are summarized in Table 4-4. There are commands for Interface Setup, Instrument Setup and Control Setup.

The Output Statement Requests are sent by the BUS CONTROLLER to the Model 805 to tell the 805 what data to output when data output is requested. These requests are listed in Table 4-5 and the data formats are described in detail in the following tables as well as the adjoining text associated with those tables.

4.7 INSTRUMENT SETUP COMMANDS AND REQUESTS

4.7.1 EOI Status - The ZN_1 Command

When EOI (end or identify) is enabled ("Z0"; Table 4-6), the EOI line is set active concurrent with the last byte of a transfer. Use of EOI identifies the last byte allowing for variable length data transmissions. EOI can be disabled ("Z1"; Table 4-6).

4.7.2 Interface Mode - the MN_1 Command

4.7.2.1 Local - This message ["M0"; Table 4-6] clears the remote operation of the Model 805 and enables front panel operation. Pressing the front panel +/- button for

Table 4-4. Model 805 Command Summary of Instrument Setup

Summary of Input Command Formats. Choices of the commands are:	
Table 4-6	Interface Setup Commands: ZN_1 Selects EOI status MN_1 Selects Remote Interface Mode TN_1 Changes terminating Characters C "Clear" Command
Table 4-7	Instrument Setup Commands: $F0C_1$ Select Control Units F1A,F1B1 Select Display Sensor AC_1C_2,BC_1C_2 Input A ID and B ID
Table 4-8 4-9	Control Setup Commands: S,etc Set Point Input PN_1N_2,etc. Proportional (GAIN) IN_1N_2,etc. Integral (RESET) RN_1 Heater Range

longer than one second also sets the instrument to local, provided the button has not been disabled by the Local Lockout Message (see Section 4.7.2.3).

See Section 4.5.6 for a discussion of the Model 805 under local operation while acting as a TALKER.

4.7.2.2 Remote - The Model 805 is in the local front panel mode when first turned on. A remote message ["M1"; see Table 4-6] allows the 805 to be controlled over the IEEE-488 interface. In Remote, the front panel controls are disabled (except the LOCAL button) and are then controllable over the IEEE Bus. The instrument's initial set up is determined by the front panel settings at the time when the instrument is placed into Remote. The Model 805 may also be placed into remote by pressing the +/- button on the front panel for more than one second or addressed to talk by the BUS CONTROLLER.

4.7.2.3 Local Lockout - This message ["M2"; Table 4-6] disables the Model 805's Local Front Panel controls, including the LOCAL button. The message is in effect until the message is cleared over the Bus or power is cycled. Many IEEE-488 cards (for IBM PC's) automatically place addressed instruments into Local Lockout. To be able to place the Model 805 into Remote without Local Lockout the user may need to reconfigure his IEEE-488 card.

4.7.3 Terminating Characters - The TN_1 Command

Terminating characters ["T0", "T1", "T2" and "T3"; Table 4-6] are used to indicate the end of a record. Record terminators are used when the unit has completed its message transfer. Switch 1 of the IEEE address defines the terminator status. If switch 1 is OPEN (0) the terminator status is defined as "T0" [(CR)(LF)] and terminator status can not be changed over the interface. When switch 1 is CLOSED (1) the terminator status is defined as "T1" [(LF))(CR)] and the status can be changed using the "T0", "T1", "T2" or "T3" commands.

4.7.4 Clear

The (C)lear Message [see Table 4-6] sets the Model 805 to the turn-on state. This action is similar to turning the instrument OFF and then back ON, except that it occurs in milliseconds, rather than seconds and the Model 805 does not go through the power-up display sequence.

Table 4-5. Model 805 Summary of Output Requests

Table	Request	Output
4-6	W2 WI	Interface Status Input and Option Card Data
4-7	W1	Sample, Control, A and B Input Information
4-8	WP	Set Point Data
4-9	W3	Control Data (Gain, Reset, etc.)
4-10	WS W0	Display Sensor Data Display, Control Sensors and Set Point Data

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Table 4-6. Model 805 Interface Setup Commands and Request Status

Command	Functional Description
ZN_1[a]	Selects IEEE EOI status. Forms of the command are Z0 and Z1. When N_1 is: — EOI Status is: 0 — EOI line is set/accepted on last character input or output. 1 — EOI line is not set on last character output or acknowledged on input.
MN_1	Selects Remote Interface mode. Forms of the command are M0, M1 and M2. When N_1 is: — Mode is: 0 — Local 1 — Remote 2 — Remote with Local Lockout
TN_1	Changes terminating characters (when IEEE Address Switch #1 is CLOSED [1]). Forms of the command are T0, T1, T2 and T3. When N_1 is: — Terminators are:[b] 0 — (CR)(END[c] ^ LF) [also with Switch OPEN] 1 — (LF)(END ^ CR) [default, unless changed] 2 — (END ^ LF) 3 — (END ^ DAB[d])
C	"Clear" command, returns unit to power up state (Restart).

****

Request	Functional Description
W2	Interface Status - ZN_1,MN_2,TN_3 8 Characters plus up to 2 Terminators where: ZN_1 is EOI status. MN_2 is Mode status. TN_3 is Terminator status.
WI	Input and Option Card Data[e] A-C_1C_2,B-C_3C_4,1-$C_5C_6C_7C_8$,2-$C_9C1_0C1_1C1_2$ 23 Characters plus up to 2 Terminators where: C_1C_2 is the A Input Module. C_3C_4 is the B Input Module. C_5-C_8 is 8055 if the Linear Analog Option is Present C_9-$C1_2$ is 8053 or 8054 if the RS-232C or IEEE-488 Option is present.

a) N_i corresponds to a numeric value (0 - 9)
b) The AND symbol (^) is used to indicate messages sent concurrently.
c) END = EOI; d) DAB = last data byte
e) C_i corresponds to an alphanumeric (0 - F)

4.7.5 The "W2" Data String

For the case of W2, the data string would have the following format:

Z0,M2,T1[TERM1][TERM2]

where the Z0, M2 and T1 are defined in Table 4-6.

4.7.6 The "WI" Data String

This Data String gives the input module present (d3, d6, P2, P3 or R1) in Input A and B, whether the analog option is presentand the interface option, if present. A typical data string would be:

A-d3,B-P2,1-8025,2-8054(CR)(LF)

which indicates a standard 3 volt input for Input A; a 100 ohm platinum input for Input B; a linear analog output option in Option Slot 1 and an IEEE-488 option in Option Slot 2.

4.8 SELECTION OF SET POINT UNITS, INPUT UNITS, DISPLAY SENSOR, AND RESOLUTION (Table 4-7)

4.8.1 Units for Set Point - The $F0C_1$ Command

The $F0C_1$ command sets the temperature or sensor units for the set point. Note that only one choice of sensor units (volts or ohms) is available and that it is selected automatically based on the control input module present. Consequently, the command for selecting sensor units for control is F0S. Temperature units are selected with the same command with K, C, or F substituted for S. The display units are the same as the set point units and the same for each input.

4.8.2 Display Sensor Selection - The F1A and F1B Commands

This command selects the sensor input to be displayed independent of the input selected for control.

4.8.3 The A and B SENSOR ID Information - The AC_1C_2 and BC_1C_2 Commands

The information for these commands is sent to the Model 805 to set the functional parameters as described in Table 4-7.

Table 4-7 defines the AC_1C_2 and BC_1C_2 definitions as independent functions. If multiple functions are to be selected, the character equivalents are additive (see examples below, which are given as SENSOR A ID's - they pertain to SENSOR B ID's as well).

A20 - Disable digital filtering and select Sensor Curve 02 to be used to determine temperature.

A22 - Enable digital filtering and select Sensor Curve 02 to be used to determine temperature.

4.8.4 The SENSOR ID on Return to Local

When the Model 805 is returned to local, the SENSOR ID's on the back panel are read and data entered over the IEEE-488 Bus using the commands AC_1C_2 or BC_1C_2 is lost.

4.8.5 The "W1" Data String

This Data String gives the Display, Control, A and B information. The data string will have the following format:

A,B,K,K,A20,02,B42,04(CR)(LF)

The above string indicates that the Display Sensor is A; the Control Sensor is B; both are in kelvin units; the SENSOR A ID indicates that the Digital Filtering for this channel is ON and the curve selected is number 2; the curve being used for Input A is 2; the SENSOR B ID indicates that Digital Filtering for this channel is ON and the curve assigned is 4; the curve being used is also 4. Both channels

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Table 4-7. Model 805 Command Summary for Instrument Setup

Functional Description	
Selection of Units, Sensors, Resolution, and Deviation	
$F0C_1$	Function 0 - Select Set Point (Control) Units. Forms of the command are F0K (kelvin), F0C (celsius), F0F (fahrenheit), and F0S for Sensor Units in volts or ohms.
$F1C_1$	Function 1 - Select Display Sensor (Input A or Input B) Forms of the command are F1A and F1B.
AC_1C_2 or BC_1C_2	Input A ID and B ID. C_1C_2 are 00 thru FF. Forms of the command are A00 thru AFF. C_1 ranges between 0 and F, and selects the Sensor Curve number 00(0) thru 15(F). C_2 C_1 1 2 3 4 4 3 2 1 — 4 is MSB, 1 is LSB 1 2 3 4 5 6 7 8 — Switch Nos on SENSOR ID 1 2 4 8 8 4 2 1 — Binary Weighting Digital Filtering

****

Request	Functional Description
W1	A and B Input Information $C_1,C2,C_3,C_4,AC_5C_6,N_1N_2,BC_7C_8,N_3N_4$ 21 characters plus up to 2 terminators where: C_1 is the Display Sensor A or B. C_2 is the Control Sensor A or B. C_3 is the Set Point Units K, C, F, V or R. C_4 is the Display Units K, C, F, V or R. C_5C_6 is the A ID (00 through FF). N_1N_2 is the A Curve Number (00 through 15). C_7C_8 is the B ID (00 through FF). N_3N_4 is the B Curve Number (00 through 15).

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are using the DT-470 "Curve 10", the difference is that INPUT A is set for an upper limit of 325K and INPUT B is set with an upper limit of 475K.

4.9 THE CONTROL COMMANDS

4.9.1 The Set Point Value - The S Command

The set point is sent from the controller to the Model 805 in a free field format of which examples are given in Table 4-8. Note that the sign only has to be present if negative celsius or fahrenheit settings are desired. Although the limits on the input range above the values possible for the various sensors, the set point is limited by the input module present as shown in the table. Note that the temperature limit can be different for the DT-470 depending on whether curve number 02 (324.9K) or curve number 04 (474.9K) has been selected. If a number above the limitation for the module is entered, the set point is set to the upper temperature limit. Also note that an S sent by itself to the 805 sets the set point to 0 kelvin (or its equivalent in the units chosen) which will result in shutting down the heater output stage of the temperature controller.

Note: Although limitations on the range of the set point are set within the software when in temperature units; these limits are not possible for sensor units due to the different characteristics for each sensor.

4.9.2 The "WP" Request Data String

This request is a subset of the "WO" command; the "WP" command giving the set point value by itself.

4.9.3 Setting the GAIN (Proportional) - The P Command

The gain is a multiplier between 0.1 and 99., a range of 990, i.e., 99./0.1 = 990. A gain of 0.0 is not allowed. The format is free field with examples of the command being P.1, P0.1, P9, P9., P9.0, P99, P99., etc.

The string P987.12 will be interpreted as P87, i.e., the first valid combination tied to the decimal point or end of string will be retained. A P transmitted by itself is equivalent to P0 or P0.0 and sets the gain to 0.1. When returning to LOCAL, the gain setting if changed over the IEEE-488 Bus is no longer valid since the 805 will now read the front panel gain potentiometer setting.

4.9.4 Setting the RESET (Integral) - The I Command

The reset is set from 0.1 through 99 (1 to 990) seconds. Like the gain command, it is free field with the same characteristics and format. It will also revert back to front panel settings under LOCAL control. A setting of 0.0 turns the reset off.

4.9.5 Heater Range - The R Command

The heater range can be changed over the bus with the RN_1 command. R1 or R6 and up are equivalent to the R0 command (see Table 4-10).

4.9.6 NOTE: The Return to Local

Although the Set Point, Gain, Reset and Sensor ID's can be changed over the IEEE Bus with the 805 in REMOTE, when the 805 returns to LOCAL, these settings are read and updated from the hardware, i.e., the front panel (set point, gain and reset) and the SENSOR ID switches on the back panel.

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Table 4-8. Model 805 Command/Request Summary for Setpoint Setup

Command	Functional Description
S or SN_1 or $SN_1.N_2$ or SN_1N_2 or $SN_1N_2.N_3$ or $SN_1N_2N_3.N_4$ or $SN_1.N_2N_3$ etc. or ( )SN_1 or ( )$SN_1.N_2$ or ( )SN_1N_2 or ( )$SN_1N_2.N_3$ etc.	Set Point Input. The decimal point is "FREE FIELD" and its allowable position depends on the control units. Limits are Units: K — 0 through 999.9; C,F — -999.9 through 999.9; V — 0.000 through 9.999; R — 0 through 9999 The Set Point is limited based on input module and Sensor. Lower limit is 0 K (-273.1 °C or -459.6 °F).

Input Module	Sensor Type	Upper Set Point Limit K	°C	°F	Sensor Units
805-3	DT-470, DT-500	324.9	51.7	125.1	2.999 volt
805-6	TG-100, TG-120	"	"	"	6.554 volt
805-3	DT-470	474.9	201.7	395.1	2.999 volt
805-P2	PT-100 Series	799.9	526.7	980.1	299.9 ohms
805-P3	PT-1000 Series	"	"	"	2999. ohms
805-R1	Rhodium-iron	"	"	"	99.9 ohms

****

Request	Output of Instrument Data
WP	Set Point Data - ( )$N_{11}N_{12}N_{13}$(.)$N_{14}N_{15}$( ) 8 Characters plus up to 2 terminators where the N_{11}-N_{15} variations are the same as for W0 (see Table 4-15).

4.9.7 The "W3" Data String

The settings for the gain, reset, heater range as well as the instantaneous % of Heater Power can be transmitted from the Model 805 with the "W3" command.

The command "SPIR" or any combination without a value following the letter sets the chosen parameters to 0, e.g., "SP" sets the set point and gain to 0.

4.10 COMMAND OPERATIONS

The following example in HP Basic sets the set point to 123.4 K, the gain to 45, the reset (integral) to 30, the heater range to 10^{-1} and the output statement to be W1.

```
OUTPUT  712 ; "S123.4P45I30R4W1"
                              └── Data
              └── 12 = 805 preset address
                   7 = IEEE card address
        └── Output Data Command
```

Table 4-9. Model 805 Command/Request Summary for the Control Parameters

Command	Functional Description
	Setting of all other Control Parameters
$PN_1.N_2$ or PN_1N_2	Proportional (GAIN). N_1N_2 is 0.1 through 99. Examples the command are P, P0, P0.0 and P99.
$IN_1.N_2$ or IN_1N_2	Integral (RESET). N_1N_2 is 0.0 (OFF) through 99. (three characters including the decimal point). Forms of the command are I0 (I0.0) through I99.
RN_1	Heater Range. N_1 is 0 through 5. Forms of the command are R0 through R5. N_1 Range Heater Current 0 OFF 0 1 OFF 0 2 OFF 0 3 -2 100 mA 4 -1 330 mA 5 MAX 1 A

****

Request	Functional Description
W3	Control Parameters $N_1N_2N_3,N_4N_5N_6,N_7,N_8,N_9N_{10}N_{11}$ 13 characters plus up to 2 terminators where: $N_1N_2N_3$ is the Gain Value $N_4N_5N_6$ is the Reset Value N_7 is the Heater Range $N_8N_9N_{10}$ is the % of Heater Power or Current out.

If the user were to monitor the IEEE-488 Bus when the computer sent its command string over the Bus, the following IEEE-488 Format would be observed.

? U , S123.4P45I30R4W1 (CR)(LF)

The Universal Unlisten Command (?) is sent so that no other instruments on the Bus will eavesdrop on the Bus and assume that the data being sent is for their attention. The Model 805's Talk Address (L) is sent to unaddress any existing TALKER. Note that the BUS CONTROLLER could have designated another instrument as the TALKER. Therefore, to keep the format consistent, it must send a Talk Address even when the Model 805 is going to be that TALKER. The Listen Address (,) must be sent to tell which instrument on the Bus is to receive the Data String. Note that [TERM1][TERM2] have been indicated to be CR LF (carriage return, line feed); these are the correct terminators for the HP computer example.

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Note that the string "P45I30P40" would result in a gain of 40 and an integral value of 30, i.e., only the last value sent over the bus for that program code will be entered after the appropriate terminators have been sent over the bus.

4.10.1 Output Data Statements

The Model 805's Output Requests for Data Statements are summarized in Table 4-5.

The Model 805 will always respond when asked to talk with the last command sent to it, i.e., if W0 is sent once then the 805 will always output the W0 information whenever it is asked to talk as long as it has not received another output data statement.

4.10.2 The "W0" Data String

The following example in HP Basic illustrate the commands associated with obtaining output data from the Model 805. The addition of the M0 command returns the instrument to front panel control where it stays even when data is requested from the 805 by the HP computer.

```
10  DIM A$ [19]
20  OUTPUT  712; "W0M0"
30  ENTER   712; A$
```

The following information is sent across the bus in the IEEE-488 format as a result of the above software commands.

Command mode sent:
? U , W 0 M 0 (CR)(LF)

Data returned:
? 5 L +123.45K,+123.40K (CR)(LF)
- ? — Universal Unlisten Command
- 5 — BUS CONTROLLER's Listen Add
- L — 805's Talk Address
- +123.45K,+123.40K — Data returned

The data above indicates that the display temperature is 123.45K and that the set point is 123.40K.

Table 4-10. Model 805 Output Data Statements

Request	Output of Instrument Data
WS	Sample Sensor Data - $( )N_1N_2N_3(.)N_4N_5( )$ 8 Characters plus up to 2 Terminators where the N_1-N_5 variations are the same as for W0 (see below).
W0	Sample (WS) and Set Point (WP) Data $( )N_1N_2N_3(.)N_4( ),( )N_5N_6N_7(.)N_8( )$ 15 characters plus up to 2 terminators where: (.) may vary in position dependent on units and temperature. $( )N_1$-$N_4( )$ is the Sign, Display Sensor reading and units. $( )N_5$-$N_8( )$ is the Sign, Set Point and units. Examples of the Display reading are $(\pm)N_1N_2N_3(.)N_4$(F), $( )N_1N_2N_3(.)N_4$(R) or $( )N_1(.)N_2N_3N_4$(V) Note that all are "free field" where the units are K, C, F, V or R and the sign ( ) may be $(\pm)$ for the ° and °C scales.

4.11 SAMPLE PROGRAMMING

4.11.1 HP86B Keyboard Interactive Program

The following program for the HP86B is an interactive program with the keyboard of the computer. For example, when the user sees the prompt on the screen and types in a valid Model 805 command such as "W0", the program will result in the display of the Model 805 response on the screen.

```
10  REM Set IEEE Address to 12
20  REM Address Switch 1 OPEN(0) to get (CR)(LF)
30 REM This program allows the user to communicate with the 805, interactively
       from the computer keyboard
40  DIM A$[100]                    ! Must be increased for curve information
50  INPUT B$                       ! INPUT KEYBOARD COMMAND
60  OUTPUT 712 ;B$                 ! SEND COMMAND TO 805
70  ENTER 712 ; A$                 ! RECEIVE ANSWER FROM 805
80  DISP A$                        ! DISPLAY ANSWER
90  GOTO 50
100 END
```

4.11.2 National Instruments GWBASIC or BASICA IBM Example

The following is the same program written for the National Instruments GPIP-PC2 IEEE-488 Card for IBM PCs and Compatibles using Quick Basic 3.0.

```
10  CLEAR,60969                    ! BASIC DECLARATIONS
20  IBINIT1 = 60969                ! This number is different for each computer
30  IBINIT2 = IBINIT1 + 3
40  BLOAD "bib.m",IBINIT1
50  CALL IBINIT1(IBFIND,IBTRG,IBCLR,IBPCT,IBSIC,IBLOC,IBPPC,IBBNA,IBONL,
IBRSC,IBSRE,IBRSV,IPPAD,IBSAD,IBIST,IBDMA,IBEOS,IBTMO,IBEOT,IBRDF,IBWRTF)
60 CALL IBINT2(IBGTS,IBCAC,IBWAIT,IBPOKE,IBWRT,IBWRTA,IBCMD,IBCMDA,IBRD,IBRDA,
IBSTOP,IBRPP,IBRSP,IBDIAG,IBXTRC,IBRDI,IBWRTI,IBRDIA,IBWRTIA,IBSTA%,IBERR%,
IBCNT%)
70  TEMP$="805"                    ! 805 is IEEE address label set up in IBCONF
80  CALL IBFIND(TEMP$,TEMP%)       ! Required command to address 805
90  A$=SPACE$(255)                 ! 255 largest transfer allowed by IBM format
100 INPUT B$                       ! Entered from keyboard while running
110 B$=B$+CHR$(13)+CHR$(10)        ! Add CR and LF to command
120 CALL IBWRT(TEMP%,B$)           ! Send command to 805
130 CALL IBRD(TEMP%,A$)            ! ENTER from 805 (SEE NOTE BELOW)
140 PRINT A$                       ! Display received information on screen
150 A$=SPACE$(255)                 ! Clear A$
160 GOTO 110
170 END
180 REM  The 805 will return the data requested, but if the command input
190 REM  does not request new information, the 805 will give the information
200 REM  last requested.
```


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4.11.3 National Instruments QUICK BASIC IBM Example

```
'   IEEE-488 TEST PROGRAM   Quick Basic 3.0 Example
'   THIS PROGRAM WAS WRITTEN FOR THE NATIONAL INSTRUMENTS GPIP-PC2
'   IEEE-488 CARD FOR IBM PC AND COMPATIBLES
'   This program will allow the user to communicate with Lake Shore's
'   instruments, interactively from the keyboard of an IBM compatible
'   computer which has a National Instruments GPIB-PC2 installed.

            common shared IBSTA%, IBERR%, IBCNT%
            TEMP$="dev12"
            call IBFIND(TEMP$,TEMP%)   'Required command to address instrument
            A$=space$(10000)
Loop1:      input B$                    'Entered from keyboard while running
            B$=B$+chr$(13)+chr$(10)     'Add CR and LF to command
            call IBWRT(TEMP%,B$)        'Send command to instrument
            call IBRD(TEMP%,A$)         'ENTER from instrument (SEE BELOW)
            FOR I = 1 to 10000
            C$ = MID$(A$, I,1)
            IF C$ = CHR$(13) THEN GOTO Loop2
            PRINT C$;
            NEXT I
Loop2:      PRINT
            A$ = space$(10000)            'Clear A$
            GOTO Loop1
            END
'   Lake Shore Cryotronics instruments will return the data requested, but
'   if the command input to the instrument does not request any information
'   the instrument will respond with the information last requested.
```

4.11.4 HP86B Bus Commands Program

The following program is for the HP86B and exercises the various bus commands.

```
10  REM Set IEEE Address to 12
20  REM Address Switch 1 OPEN (0) to get (CR)(LF)
30  DIM A$[25]                                  ! For longest string
40  OUTPUT 712;"W0"                             ! Note W0
50  ENTER 712;A$                                ! Ask for string W0
60  DISP "W0 = ";A$                             ! Display string W0
70  DISP "Display Sensor =";A$[1,8]             ! Display Sensor reading
80  DISP "Set Point =";A$[10,17]                ! Display Set Point Reading
90  DISP                                        ! Space a Line
100 OUTPUT 712;"W1"                             ! A and B Input information
110 ENTER 712;A$                                ! Ask for string W1
120 DISP "W1 = ";A$                             ! Display string W1
130 DISP                                        ! Space a Line
140 OUTPUT 712;"W2"                             ! Interface Status
150 ENTER 712;A$                                ! Ask for string W2
160 DISP "W2 = ";A$                             ! Display string W2
170 DISP                                        ! Space a Line
180 OUTPUT 712;"W3"                             ! Control Data (Gain, Reset, etc.)
190 ENTER 712;A$                                ! Ask for string W3
200 DISP "W3 = ";A$                             ! Display string W3
210 DISP "Gain =";A$[1,3]                       ! Display Gain setting
```

```
220 DISP "Reset =";A$[5,7]                ! Display Reset setting
230 DISP "Heater Range =";A$[9]           ! Heater Range
240 DISP "% Power =";A$[11,13]            ! % Power
250 DISP                                  ! Space a Line
260 OUTPUT 712;"WS"                       ! Set for WS
270 ENTER 712;A$                          ! Ask for string WS
280 DISP "WS = ";A$                       ! Display Sensor Reading
290 DISP                                  ! Space a Line
300 DISP                                  ! Space a Line
310 OUTPUT 712;"WP"                       ! Set for WP
320 ENTER 712;A$                          ! Ask for set point data
330 DISP "WP = ";A$                       ! Display string WP
340 DISP                                  ! Space a Line
350 OUTPUT 712;"WI"                       ! Set for WI
360 ENTER 712;A$                          ! Ask Input Cards and Options
370 DISP "WI = ";A$                       ! Display string WI
380 END
```


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S E C T I O N V

M A I N T E N A N C E

5.1 INTRODUCTION

This section contains information necessary to maintain the Model 805. General maintenance, fuse replacement, line voltage selection and performance testing is contained in this section.

5.2 GENERAL MAINTENANCE

Clean the 805 periodically to remove dust, grease and other contaminants. Use the following procedure:

1. Clean the front and back panels and case with a soft cloth dampened with a mild detergent and water solution.

Note: **DO NOT** use aromatic hydrocarbons or chlorinated solvents to clean the 805. They may react with the plastic materials used in the unit or the silk screen printing on the back panel.

2. Clean the surface of the printed circuit boards (PCB) using clean dry air at low pressure. If grease is encountered, spray with Freon T.F. degreaser and remove grime with dry, low-pressure air.

5.3 FUSE REPLACEMENT

The line fuse is accessible from the rear of the 805. Use the following procedure to check and/or replace the fuse:

WARNING

To prevent shock hazard, turn off the instrument and disconnect it from AC line power and all test equipment before replacing fuse.

1. Set the POWER switch to OFF and disconnect the power cord from the unit. The fuse compartment is located just above the power connector.

2. Open the fuse compartment by prying open the cover with a small screw driver.

3. Remove the right fuse holder by sliding it out of its position with the aid of the small screw driver.

CAUTION

For continued protection against fire hazard, replace only with the same type and rating of fuse as specified for the line voltage selected.

4. Replace the fuse per Table 2-1.

5. Replace fuse holder, close fuse compartment and connect power cord.

5.4 LINE VOLTAGE SELECTION

The rear-panel, three-pronged line power connector permits the 805 to be connected to 100, 120, 220, or 240 VAC line voltages. Use the following procedure to change the line voltage:

WARNING

To prevent shock hazard, turn off the instrument and disconnect it from AC line power and all test equipment before changing the line voltage selection.

1. Open fuse compartment cover using procedure in Section 5.3.

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2. Remove voltage selector wheel and insert with the proper voltage facing out. Note that the wheel can only be inserted with the writing read right side up.

3. Install the proper fuse as outlined in Section 5.3.

5.5 OPERATIONAL CHECKS

If unit fails operational checks, see Section 5.7 (Troubleshooting).

5.5.1 Test Connector

A test connector for the rear panel SENSORS/MONITORS connector J1 to simulate sensor inputs is required for operational checks of the 805. The test connector can be made by taking the solder pin plug supplied with the 805 and configuring two resistors to simulate the Input A and Input B sensors in the two-wire configuration as shown in Figure 2-2. The test resistors specified in Table 5-1 are used in the operational checks.

5.5.2 Operational Test Procedure

The operational performance test is designed to verify the overall operation of the 805 and can be used as a periodic maintenance check. The following equipment is used in the test.

1. Digital Voltmeter (DVM) - 4 ½ digit resolution or better.

2. Verification Connector - fabricated per Section 5.5.1.

Complete the following set-up procedure for this test.

1. Connect the DVM across the test resistor of Input A.

2. Connect the 805 to line power and turn the unit ON. Verify that the 805 initializes to the proper POWER-ON state as defined in Section 3.6.1.

The following procedure is used to test the overall 805 operation.

Note: The unit should be allowed a one hour warm-up time to achieve rated specifications.

5.5.3 Current Source Check

The DVM across the test resistor should read as follows (Refer to Table 5-1 for resistance values):

805	1.0000V ± 100μV
805-6	1.0000V ± 100μV
805-P2	0.10000V ± 10μV
805-P3	0.10000V ± 10μV
805-R1	0.03000V ± 10μV

5.5.4 Temperature Display

5.5.4.1 Determine Input Type - The first step to check the instrument's display and operation is to determine the type of sensor input.

a. The type of input module(s) installed in the Model 805 is located on the front page of every 805 manual.

b. The 805 displays the type of input module(s) installed in the A and B inputs sequentially when the instrument is powered on. Possibilities are d3, d6, P2, P3 or r1.

c. The type of input can also be displayed by holding down the appropriate sensor display key (A or B).

5.5.4.2 Check Units Display- Verify that the units can be changed by pushing in the UNITS key to change the units in sequence; K, F, V, C, K, etc. (Note: the unit goes to V for a diode configuration or Ω for a resistance module.

5.5.4.3 Check Sensor Units Reading Next, check to see if the instru-

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ment is reading the correct units (volts or ohms) value for the appropriate test resistor from Table 5.1. The reading should match the value given in the Display in Sensor Units column of Table 5-1. The allowable error is provided in the Input A/D Accuracy column.

5.5.4.4 Check Temperature Reading- Confirm that the temperature in kelvin displayed corresponds to the selected curve number.

a. Check the Sensor Curve Table (Table 2-3 or below) to determine the curve number that selects the standard curve or precision option that is needed.

b. Set the SENSOR ID switches as described in Section 2.3.8.

Curve No.	Switch 45678	Temperature Displayed,K	Curve
00	00000	71.79	DRC-D
01	00001	71.42	DRC-E1
02	00010	87.77	CRV 10
03	00011	273.1	DIN-PT
04	00100	87.77	CRV 10

5.5.4.5 Check Input B - Repeat the above process by verifying the current source and the A/D settings for this input.

5.5.5 Heater Output Test

5.5.5.1 Heater Output Conditions- The heater should output power when the setpoint temperature is above the display temperature, as long as the heater is on and a gain value has been set. If the sensor is a diode, the voltage across the device will change inversely with temperature. Therefore the higher the voltage the lower the temperature. For Platinum sensors the resistance increases as the temperature increases.

5.5.5.2 Test Setup - Test the heater by placing an appropriate test resistor (see Table 1) in to the sensor input, and place a 10 ohm (at least 10 watts) up to 25 ohm (at least 25 watts) resistor across the heater terminals.

5.5.5.3. The Heater Display - The heater display is shipped from the factory reading the percent of power out. If the heater is 10 ohms then at 100 percent the heater will have 1 amp through it and 10 volts across it. If the heater is reading 50 then the instrument is delivering 5 watts(0.707 amps and 7.07 volts) to the 10 ohm load. If the unit is reading in current a reading of 50 will mean 2.5 watts (0.5 amps and 5 volts). The heater display can be changed from power to current by switching internal dip switch S4-1.

5.5.6 Checking Gain and Reset

5.5.6.1. Gain - With a heater load connected to the heater terminals and a test resistor connected to the control sensor input, enter a setpoint above the control sensor reading. Next, enter a gain value. The heater display should now indicate that power is being delivered to the heater. The amount of power is a scaled factor of the error signal times the gain ([Sensor voltage - Setpoint voltage] * Gain). If the setpoint temperature is increased or the gain is increased the output power will increase.

5.5.6.2 Reset - Set up the controller as instructed in step 5.5.6.1. Enter a gain and setpoint value that results in less than full power to the load. If a Reset value is now entered, the instrument will try to integrate out the error. With a test resistor in the control sensor input and a fixed setpoint, the error signal will be constant. With a constant error

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the Reset will continue to increase the analog output control signal until the heater display reads 100 percent. If the heater output increases to approximately 100 percent for these conditions the reset circuit is operating.

5.5.7 Checking the Heater Ranges

5.5.7.1 Standard 25 Watt output - Set up the unit so that 100 percent is output to the heater load. At full power out on the Max or HI scale 1 amp should be through the resistor, as long as the resistor is 25 ohms or less. The heater circuit has a compliance voltage limit of 25 volts, so a resistor larger than 25 ohms will limit the current to 25 divided by the load's Resistance. If the next lower range (MED) is selected then the heater will put 0.33 amps through the resistor at 100 percent. The LO range (low) will output 0.10 amps at full scale output.

5.5.7.2 W60 60 Watt Option - If the unit has a W60 output option the Max or HI scale has a 1.55 amp, 40 volt limit. If a 25 ohm resistor is used the controller will supply 60 watts to the load. If a 100 ohm resistor is used on the Max scale the unit will output 40 volts at 0.4 amps or 16 watts. The lower ranges are scaled as explained in 5.6.4.1 above except the voltage limit is 40 volts.

NOTE: The values given above are nominal values. If they are slightly off it should not effect operation since the heater circuit is part of a feedback loop.

5.6 CALIBRATION

The adjustments and test points referred to in this section are labeled on the instrument calibration cover. Remove the two top panel screws and slide the top cover off to gain access to the adjustments and test points.

Note: The unit should be allowed a one-hour warm-up time to achieve rated specifications. This calibration procedure is for an 805 in the standard diode configuration for both the A and B inputs. For a configuration other than a standard configuration, refer to Section VI for the specific Input Conversion Module present in the unit.

5.6.1 Sensor Input Module Calibration

For other than the standard diode input, calibrate each input module as specified in Section VI for that module. This includes current and Input Amplifier for resistors.

5.6.2 Current Source Calibration

Connect the voltage leads of the DVM across the 100K test resistor for Input A and adjust the A-I trimpot until the voltage across the resistor is exactly 1.0000 volt. Repeat this procedure for Input B.

5.6.3 A/D Converter Calibration

Select the 00 curve for the SENSOR A ID and the A input for display with kelvin units. Connect the voltage standard across the V+ and V- pins of the A input on the J1 SENSORS/MONITORS Connector. Set the Voltage Standard to 1.0046 volts and adjust the trimpot marked A/D on the calibration cover until the display reads 70.0 kelvin.

If a Voltage Standard is not available, then connect the 100K precision resistor across the I+, V+ to the V-, I- pins of the A input and adjust the A/D trimpot until the display reads 1.000 volts, or for a more accurate calibration, select a kelvin display and adjust the display until it reads 71.79 kelvin.

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5.6.4 Set Point Calibration

Place the ground of the DVM into TP1(GND(2s)) and the positive lead into TP2(SP V). Change the display units to voltage. Set the set point to 0 volts and adjust SP ZERO ADJ until the DVM reads 0.0000 volts. Set the set point to 2.200 volts and adjust the SP SPAN ADJ until the DVM reads -2.2000 volts. Repeat until neither reading changes.

5.6.5 Heater Meter Calibration

Connect a load resistor of appropriate resistance and wattage (normally 25 ohms and 25 watts) in place of the load heater. Set up the 805 so that not more than 50% heater power is set. Place the low lead of the DVM into TP6(PWR V-), the high lead into TP5(HTR+V) and adjust PWR V- ADJ until the DVM reads 1.000 volts. Then place the low lead of the DVM into TP8 (PWR LOW), the high lead into TP7 (PWR VREF) and adjust PWR VREF ADJ until the DVM reads 1.000 volts.

5.6.6 Output Current Adjust

Place the high lead of the DVM into TP5 (HTR+V), the low lead into TP9 (PWR V+) and adjust PWR V+ ADJ until the DVM reads 1.000 volts.

5.7 TROUBLESHOOTING

5.7.1 Checking the Temperature Reading

5.7.1.1 Sensor Current - The first step in checking the operation of the temperature reading is to use a test resistor as specified in Table 1 for the appropriate input. The voltage across the resistor should be the resistance value times the current value given in Table 1's Sensor Current column. The voltage value should be accurate to within 0.0001 volts of the voltage value given by multiplying the test resistance times current value. For example the voltage for a 805-P2 should be 100 ohms times 0.001 amps = 0.1000 volts. If the voltage value is incorrect then the current trimpot will need to be adjusted.

5.7.1.2 Monitor Voltage - The voltage across the sensor or test resistor is also available on the monitor plug. The connections are in section two of the instrument's instruction manual. The monitor voltage will equal the sensor voltage for 3 volt diode inputs and all platinum inputs(-3, -P2, -P3,-R1). If the input is a GaAlAs Diode input then the monitor voltage will be 0.458 times the sensor voltage.

5.7.1.3 Display Voltage or Resistance - The display reading in volts or resistance should match the monitor reading and the voltage across the sensor. The voltage across the sensor will match the display for the 6 volt input cards except the monitor reading will be 0.458 times the sensor reading. If the readings do not match then the A/D should be calibrated.

If display and sensor voltage is correct but monitor voltage is incorrect the input may control at an offset or not at all.

If the sensor voltage matches the monitor voltage and the display voltage is incorrect than the A/D needs to be calibrated. Follow the input card calibration procedure in the manual. The monitor voltage is used as the control voltage. To see the true control stability of the instrument compare the monitor voltage of the control input to the setpoint voltage. Most system can be tuned so that the control stability exceeds the resolution of the display.

5.7.1.4 Units Display is Correct But Temperature Reading is Incorrect. - If the units display match-

es the voltage or resistance value of the sensor, but the temperature display is incorrect then check the curve selected. Follow the steps given in Section 2.3.8 to be sure the correct curve has been selected. If the correct curve has been selected by the sensor ID switches on the back panel then the next step if the temperature display is still wrong is to check the curve that the Microprocessor is reading.

a. With the 805 this can be done by pressing the A or B key. The display will now show the type of input module and the curve the instrument is using.

b. The selected curve can also be read over the IEEE by using the test program given section 4.13. The command to read the selected curve is W1. Check the manual for the format of the characters returned by W1.

5.7.2 Checking Setpoint Voltage

The setpoint value is available on the Analog control card of the 805. The test points will be labeled on the calibration cover(TP1 and TP2). Select a 3 volt diode as the control input and enter setpoint values from 0.300 to 2.700 volts. The values should be negative but within ±0.0001 of the setpoint value. If a resistance module is selected as the control input the setpoint voltage will be positive.

If a 3 volt diode input is not available then check the setpoint calibration procedure given in the module section of the manual.

5.7.3 Checking the Gain and Reset

5.7.3.1 Gain - The gain voltage is created by multiplying the error signal by the gain value. To check for correct operation plug a test resistor into the control sensor input and set the setpoint above the temperature reading. Enter a gain value and observe the voltage at TP3 (gnd at TP1) change as the gain value or setpoint is changed. The value will vary between approximately -7.3 and +7.3. The value is positive if the setpoint is above the temperature and negative is if the setpoint is below the temperature reading.

5.7.3.2 Reset - Set up the controller similar to step 1, with the gain voltage at about 3 volts. The reset voltage is available on TP4. If the reset is now turned on the value should increase to the present gain voltage (TP3). The rate at which the value increases depends on the reset setting. The higher the reset setting the faster the voltage will increase.

5.7.3.3 The sum of the Gain and Reset - The sum of these two signals is the analog out signal. This is a 0 to 7.3 volt signal that determines the amount of heater output for the selected heater scale.

5.7.4 Checking the Heater Circuit

To test the output stages of the controller place a test resistor into the control input and set the setpoint above the control input. Place a 10 ohm (10 watt) to 25 ohm (25 watt) load resistor across the heater terminals of the controller and select the HI heater level.

If the instrument does not output power check to see that the LM317HVK (U19) is tightly screwed onto its heat sink. It is on stand-offs near the fan in the left rear of the unit.

To test the output stage set up the controller so that there is power to the load. This can be done by selecting a setpoint temperature above the control sensor temperature and entering a gain value.

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Next, measure the gain signal to be sure it is operating correctly. The gain signal can be measured from TP1 to TP3 on the analog control card. If this is a positive value between 0-7.3 volts, depending on the error signal and the gain setting, then the circuit is probably operating correctly. With a gain voltage of approximately 2-3 volts turn on the reset pot. The reset voltage (TP4) should increment to approximately 7.3 volts.

Now remove the calibration cover and measure the voltage across R28 (see Analog Control Card Schematic) on the analog control card. The voltage should vary from 0-1 volt as the gain varies from 0-7.3 volts. As the gain is increased this value should increase. If the voltage across R28 does not change as the gain is changed then U10 or U11 is probably bad as long as the HTR V+ value is still good. The V+ can be checked by measuring approximately 28 V from TP5 to TP1. The V+ value will be approximately 40 volts if a W60 option is installed.

If the Voltage across R28 is correct, and there is no heater power on any range then U12 or U13 are probably bad and both should be replaced. Before it is decided that U12 and U13 are bad be sure the relays K1-K4 are working. If they can be heard clicking as they are turned off and on then they are probably operating. The relays are turned off and on by selecting different heater ranges. If there is approximately 24 volts from pin 4 to pin 8 of U12 then replacing U13 should solve the heater problem. If there is 18 volts from pin 4 to pin 8 then U12 should be replaced.

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Table 1: Input Card Characteristics

Sensor Input	Sensor Type	Temp Range and Units Range	Sensor Current	Input A/D Resolution	Input A/D Accuracy	Test Resistor	Display in Sensor Units	Standard Curves	Display with Std Curves (K)
805	Si Diodes	1.4 to 475K 0-2.9999V	10μA	0.05mV	±0.1mV	100kΩ 0.01%	1.000V	DRC-D (00) DRC-E1(01) CRV 10(02) CRV 10(04)	71.79 71.42 87.77 87.77
805-6	GaAlAs Diodes	1.4 to 325K 0-6.5535V	10μA	0.1mV	±0.2mV	100kΩ 0.01%	1.000V	no std crv see note	
805-P2	100Ω Pt RTD	14 to 800K 0-299.99Ω	1mA	0.005Ω	±0.01Ω	100Ω 0.01%	100.0Ω	Din 43760 (03)	273.1
805-P3	1000Ω Pt RTD	14 to 800K 0-2999.9Ω	0.1mA	0.05Ω	±0.1Ω	1000Ω 0.01%	1000Ω	Din 43760 (03)	273.1
805-R1	RhFe RTDs	14 to 800K 0-99.999Ω	3mA	0.003Ω	±0.01Ω	10Ω 0.01%	10.00Ω	no std crv see note	

Note: To read correctly in temperature these input cards must be used with calibrated sensors and the 8001 precision option.

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5.8 MODEL 805 REPLACEABLE PARTS

This section contains component layout diagrams, schematics, and replaceable parts lists for the Model 805, and are arranged in the following order:

MODEL 805 MAIN BOARD
- Component Layout Diagram
- Replaceable Parts List
- Schematic: Power Supply
- Schematic: Current Sources
- Schematic: Analog Voltage In/Out
- Schematic: Digital Section
- Schematic: Slot Interconnections

MODEL 805 ANALOG BOARD
- Component Layout Diagram / Replaceable Parts List
- Schematic: Sheet 1
- Schematic: Sheet 2

MODEL 805 DISPLAY BOARD
- Component Layout Diagram / Replaceable Parts List
- Schematic

MODEL 805 MICROPROCESSOR CARD
- Component Layout Diagram / Replaceable Parts List
- Schematic

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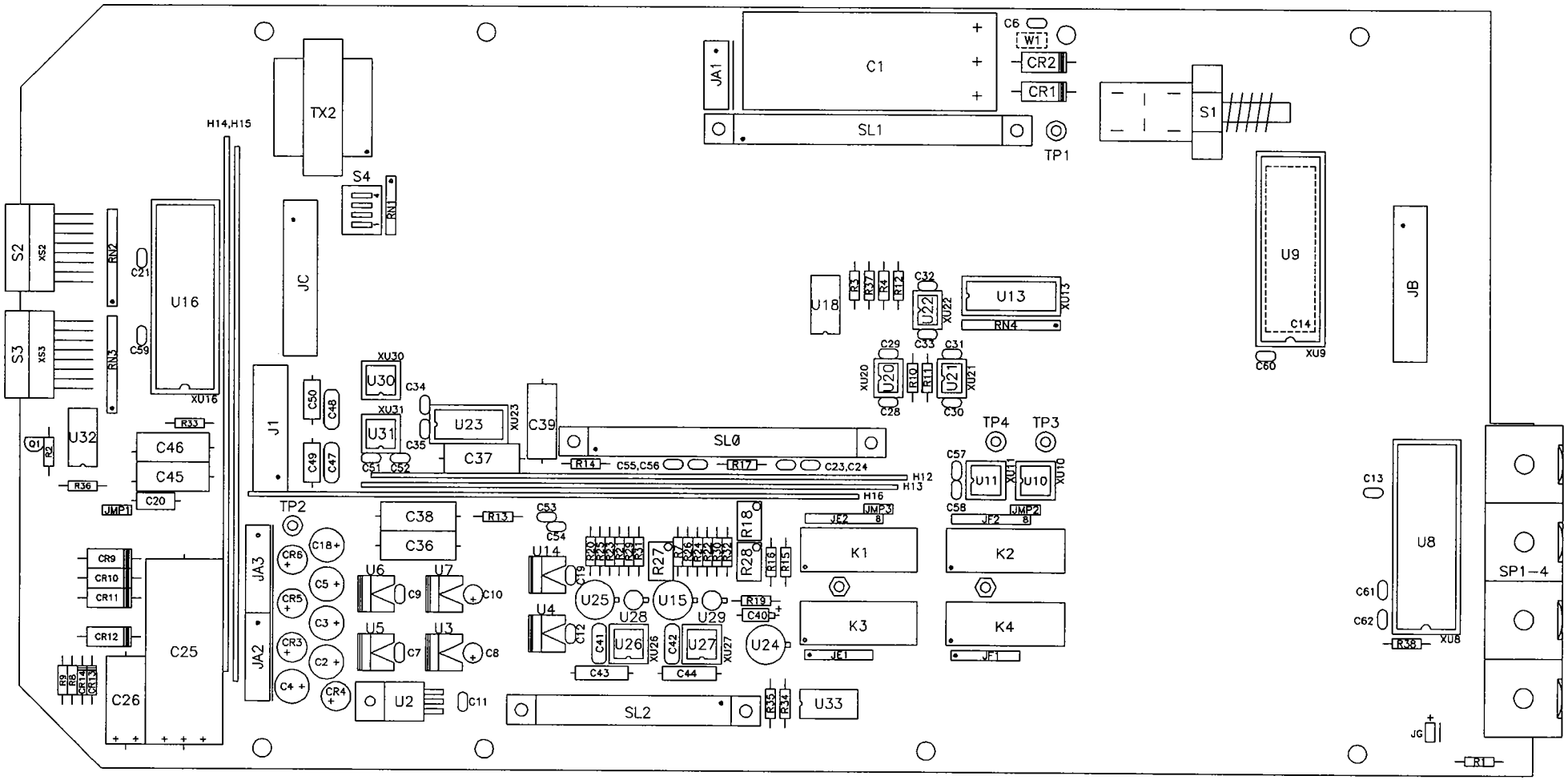
TX2
H14,H15
S4
RN1
JA1
C1
C6
W1
CR2
CR1
SL1
TP1
S1
U9
C14
XU9
C60
JB
S2
XS2
RN2
C21
U16
XU16
JC
S3
XS3
RN3
C59
U18
R3
R37
R4
R12
C32
U22
XU22
U13
XU13
RN4
C29
C33
C31
XU20
U20
R10
R11
U21
XU21
C28
C30
XU30
U30
C34
XU31
U31
C35
U23
XU23
C39
C50
C48
C49
C47
C51
C52
C37
SL0
R14
C55,C56
R17
C23,C24
H12
H13
H16
TP4
TP3
C57
U11
XU11
U10
XU10
C58
JMP3
JMP2
JF2
JE2
U32
R33
C46
C45
C20
R36
R2
JMP1
J1
TP2
C38
C36
R13
C53
C54
R18
R28
R27
R15
R16
U14
C19
U25
U15
U28
U29
U24
R19
C40
C41
U26
XU26
C42
U27
XU27
C43
C44
K1
K2
K3
K4
JE1
JF1
U8
C13
C61
C62
R38
XU8
SP1-4
JG
R1
JA3
JA2
CR9
CR10
CR11
CR12
C25
C26
R9
R10
R11
R12
CR7
CR8
C18+
C5 +
C3 +
C2 +
C4 +
CR6
CR5
CR3
CR4
U6
U7
U5
U3
U4
C9
C10
C7
C8
C11
U2
SL2
R35
R34
U33

SECTION VI

OPTION AND ACCESSORY INFORMATION

6.1 INTRODUCTION

This section contains a brief description of the options and accessories available for the Model 805 Temperature Controller. Each Option, Input Module and accessory is listed by part number in Table 6-1.

Table 6-1. Option and Accessories Model 805 Temperature Controller

PART NUMBER	DESCRIPTION
	INPUT CONVERSION MODULES
Model #	Conversion Input Module
805-6	6 volt conversion for TG-120 Series Diodes
805-P2	100 ohm platinum
805-P3	1000 ohm platinum
805-R1	27 ohm Rh-Fe
	ACCESSORIES
106-250	Model 805 Connector Kit
RM-3H1	Rack Mounting Kit
RM-3H2	Rack Mounting Kit
8072	IEEE-488 Interface Cable
8271-11	Sensor/Heater Cable
8271-12	Sensor/Heater/Output Cable
HTR-25	25 ohm cartridge heater
HTR-50	50 ohm cartridge heater
	OUTPUT POWER OPTION
W60	60 watt output stage for 25 ohm heater
	INTERFACE OPTIONS
8053	RS-232C Interface
8054	IEEE-488 Interface
8055	Analog Output Option

6.2 INPUT CONVERSION MODULES

The Input Conversion Modules are described in Section I, Table 1-1 of this Manual.

6.3 ACCESSORIES

6.3.1 Model 805 Connector Kit

The connector kit for the Model 805 consists of one 24 pin "D" style plug mate to the J1 SENSORS/MONITORS connector (LSCI Stock # 106-250).

6.3.2 RM-3H1/3H2 Rack Mount Kits

The Model 805 can be rack mounted in a standard 19 inch instrument rack using either the RM-3H1 or RM-3H2 Rack Mounting Kits. The RM-3H1 kit mounts one Style L half-rack unit in a height of 3.5 inches. The RM-3H2 mounts two half-rack units in the same space, side-by-side. (Refer to Figure 2-1 for a RM-3H1 installation with handles).

6.3.3 8072 IEEE-488 Interface Cable

The 8072 IEEE-488 interface cable is one meter long and is equipped with double-ended connectors so it may be inter-connected in serial or star patterns common in IEEE instrument configurations.

6.3.4 8271-11 Sensor/Heater Cable

The 8271-11 Sensor/Heater Cable is 10 feet (>3 meters) long with a 24 pin D-style locking receptacle with hood and a dual banana plug for power output. Included are four lead connections for two sensors as well as the power output leads. This cable is constructed from six individually shielded twisted pairs

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and mates to J1, the 24 pin D-style connector and the banana output for power on the back of the Model 805. The other end of this cable is unterminated and ready for the user to add the system connector.

6.3.5 8271-12 Sensor/Heater/Output Cable

The 8271-12 Sensor/Heater/Output Cable is the same as the 8271-11 Sensor/Heater Cable with the addition of the monitor output of sensor voltage and connections for the optional analog output. Construction is from three overall shielded twisted pairs.

6.4 OUTPUT POWER OPTION

6.4.1 W60 Output Stage

The W60 output stage for the Model 805 Temperature Controller replaces the standard 25 watt output stage with an output which is rated at greater than 1.5 amperes with a compliance of up to 43 volts resulting in a maximum power output of approximately 60 watts into a 25 ohm load.

Note: The W60 is a factory installed option and should be used with a 25 ohm load. Use of a load less than 25 ohms will result in excessive power dissipation by the output stage of the controller and heat buildup within the unit.

6.5 INTERFACE OPTIONS

6.5.1 Model 8053 RS-232C Interface

The 8053 RS-232C Interface is designed to be installed in an 805 and provides an interface with an external RS-232C instrument such as a computer, modem or CRT. The interface operates in a half duplex mode (it can transmit and receive information in one direction at a time) and data transmission is asynchronous (each character is bracketed by start and stop bits that separate and synchronize the transmission and receipt of data). The baud rate is switch selectable at 300 or 1200 baud. The interface maintains EIA voltage levels for data transmission.

6.5.2 Model 8054 IEEE-488 Interface

The IEEE-488 interface and its commands are described in Section IV of this manual.

6.5.3 Model 8055 Analog Output Option

The 8055 Analog Output is designed to be installed in a Model 805 and provide an analog voltage output of display sensor temperature in kelvin for the purpose of recording, either with a strip chart recorder or other similar device. The output resolution is 0.1mV out of 1 volt.

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805-6 6 VOLT DIODE, 805-P2 100 OHM PLATINUM, 805-P3 1000 OHM PLATINUM AND 805-R1 27 OHM RHODIUM-IRON CONVERSION INPUT MODULES

MOD.1 INTRODUCTION

This section contains information pertaining to the 805-6, 805-P2, 805-P3 and 805-R1 conversion input modules. Included are descriptions, specifications, installation, operation and maintenance information.

MOD.2 DESCRIPTION

The 805-6, 805-P2, 805-P3 and 805-R1 are designed to be installed in a Model 805 to convert either the Input A or Input B (or both with two options) to accommodate diode sensors (TG-120) series) with voltages between 0 and 6.5535 volts or positive temperature coefficient sensors such as platinum or rhodium-iron.

A calibrated sensor and 8001 Precision Option is required for the Model 805 to read accurately in temperature for the TG-120 diode sensors. This configuration will also read DT-470 and DT-500 series sensors but with reduced resolution and accuracy. See Table 6V-1.

The 805-P2 converts either Input A or B (or both with two modules) to accommodate 100 ohm platinum RTD's which conform to DIN 43760 within tolerances of ± 0.1K, have an interchangeability of 0.1% at 0°C and a temperature coefficient of 0.00385/°C from 0 to 100°C. The 805-P3 accommodates 1000 ohm platinum RTDs and the 805-R1 supports 27 ohm Rhodium-Iron RF-800-4 sensors.

MOD.3 SPECIFICATIONS

Specifications for the 805-6,-P2, -P3 and -R1 input modules are given in Table MOD-1.

Table MOD-1. Module Specifications

Sensor (ordered separately):

805-6: 6 Volt Diode Sensor
DT-470 series, DT-500 series and TG-120 series from LSCI as well as any other diode sensor.
Current Excitation: 10μA(±0.005%)
Voltage Range: 0 to 6.5535V
Resolution: 0.1 millivolts
Accuracy: 0.2 millivolts
Display Resolution: 4 digits. Displays 0.000 to 6.553 volts.

805-P2: 100 ohm platinum
PT-100 series or any other 100 ohm platinum sensor.
Current Excitation: 1mA(±0.005%)
Resistance Range: 0.0 to 299.9Ω.
Resolution: 0.01 ohms
Accuracy: 0.01 ohms
Display Resolution: 4 digits. Displays 0.0 to 299.9 ohms.

805-P3: 1000 ohm platinum
Current Excitation: 0.1mA(±0.005%)
Resistance Range: 0 to 2999 ohms
Resolution: 0.1 ohm
Accuracy: 0.1 ohm
Display Resolution: 4 digits. Displays 0 to 2999 ohms.

805-R1: 27 ohm platinum
27 ohm rhodium-iron sensor.
See Lake Shore Sensor brochures.
Current Excitation: 3 mA(±0.005%)
Resistance Range: 0.00 to 99.99Ω
Resolution: 0.003 ohm
Accuracy: 0.01 ohm
Display Resolution: 4 digits. Displays 0.00 to 99.99 ohms.

RTD Sensor Power Dissipation:
Depends on Sensor Resistance. Dissipation is the product of sensor excitation current squared and the Sensor resistance.

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MOD.4 INSTALLATION

An Input Conversion Module can be installed in the 805 as either Input A or Input B (or both with two modules). The module is factory installed if ordered with an 805 Temperature Controller or can be field installed at a later date. If field installation is required, use the following procedure.

WARNING

To prevent shock hazard, turn off the instrument and disconnect it from AC line power and all test equipment before removing cover.

1. Set the POWER switch to OFF and disconnect the power cord from the unit. Remove the two top panel screws and slide the panel off. Note on the calibration cover the position of the Input A or Input B conversion module.

2. Remove the three screws that secure the calibration cover to its clips and remove the cover.

3. The conversion module has 7 pins along one bottom edge and 8 pins along the opposite bottom edge. The 805 main board has an 8 pin keyed socket strip to the right and a 7 pin socket strip to the left of the unit as viewed from the front. Plug the conversion module into the Input A or Input B socket strips. Secure the module by threading the screw provided through the module cover and into the threaded standoff below the module and tighten the screw.

4. Install the calibration cover by reversing procedure 2.

5. Install the top panel.

MOD.5 OPERATION

The 805-6 Input Conversion Module provides the 10 microampere excitation current to the sensor The resulting sensor voltage is routed into the module and multiplied by 0.457771 (3.0000/6.5535). The sensor voltage is transferred to the J1 SENSORS/MONITORS connector for external monitoring.

The 805-P2 Input Conversion Module provides the 1 milliampere excitation current to the platinum sensor (the 805-P3 supplies 0.1 milliampere and the 805-R1 supplies 3 milliamperes). The resulting sensor voltage is routed into the module and amplified by a factor of -10 (negative 10). The amplified (-10) sensor voltage is transferred to the J1 SENSORS/MONITORS connector for external monitoring.

MOD.6 CALIBRATION

The Input Module was calibrated to specification prior to shipment. If recalibration is needed, refer to the following procedure. The following equipment is used in the calibration:

1. Digital Voltmeter/Multimeter (DVM) - 4½ digit resolution or better.

2. Precision Standard Resistor - 100 kilohms for the 805-6, 1 kilohms for 805-P3, 100 ohms for 805-P2 and 805-R1 with a tolerance of +/- 0.01% or better in all cases.

3. Precision Voltage Source - capable of supplying a voltage with an accuracy and resolution of 100 microvolts out of 10 volts for the 805-6 and 10 microvolts out of 1 volt or better for the other modules.

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The unit should be allowed a one hour warm-up time to achieve rated specifications.

Use the following procedure to calibrate the 805-6, -P2, -P3 and -R1 Input Conversion Modules.

1. Remove the two top panel screws and slide the panel off.

2. Remove the three screws that secure the calibration cover to its clips and remove the cover.

3. **Set 10 μA, 100 μA, 1mA, 3mA Current** - Connect the appropriate precision resistor across the +I and -I pins of the connector for the input the module occupies. Connect the DVM plus lead to the +I pin and the minus lead to the -I pin. Adjust the trimpot marked **M-I** on the module cover for the appropriate Input until the voltage across the resistor is equal to the sensor current times the resistance ± the tolerance of the resistor. The 805-6, 805-P2, 805-P3 and 805-R1 currents are 10μA, 1mA, 100μA and 3mA respectively.

4a **805-6 Calibrate the Sensor Signal Multiplier** - Connect the DVM plus and minus leads to the + V and -V Sensor Output Signal pins for the appropriate Input module of the J1 SENSORS /MONITORS connector. Connect the precision voltage source across the +V and -V of J1 for the appropriate input and set the standard to 1.5000 volts. Adjust the trimpot marked **M-I** on the module cover until the DVM reads as close to 0.68666 volts as possible.

4b **805-P2, -P3, -R1 Calibrate the Input -10 Amplifier** - Connect the DVM plus and minus leads to the + V and -V Sensor Output Signal pins for the appropriate Input Card of the J1 SENSORS/MONITORS connector. Connect the precision voltage source across the +V and -V of J1 for the appropriate input and set the standard to 0.0000 volts. Adjust the trimpot marked **AMP Z** on the module cover until the DVM reads as close to 0 volts as possible. Set the standard to 0.2500 volts and adjust the trimpot marked **AMP S** on the module cover until the voltage reads -2.5000 volts.

5. **A/D Calibration** - Verify the input is processing the module data correctly. For the 805-6, an input of 1.0000 volts results in a display of 1.000 volt and 5.0000 results in 5.000 volts within ±0.001 volts. An input of 0.2700 volts results in a display of 270.0 ohms for the 805-P2, 2700 ohms for the 805-P3 and 81.00 ohms for the 805-R1.

   A more accurate calibration of the A/D converter can be done in temperature. For the 805-6 module, select the 00 curve and in kelvin adjust the display to read 71.79 with a 1.0000 volt input.

6. **Set Point Calibration** - Place the ground of the DVM into TP1(GND(2s)) and the positive lead into TP2(SP V). Set the display units to sensor units. Set the set point to 0.0 and adjust SP ZERO ADJ until the DVM reads 0.0000 volts. Set the set point to 100 (805-P2, 805-R1) or 1000 (805-P3) ohms and adjust the SP SPAN ADJ until the DVM reads 1.000 volts (805-P2, 805-P3) or 3.000 volts (805-R1). Repeat until neither reading changes.

7. Install the calibration cover by reversing procedure 2.

8. Install the top panel.

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MOD.7 REPLACEABLE PARTS

Included in this section are the 805-6, 805-P2, -P3, -R1 input conversion module schematics, replaceable parts lists and illustrated component layouts. Refer to the manual for ordering information.

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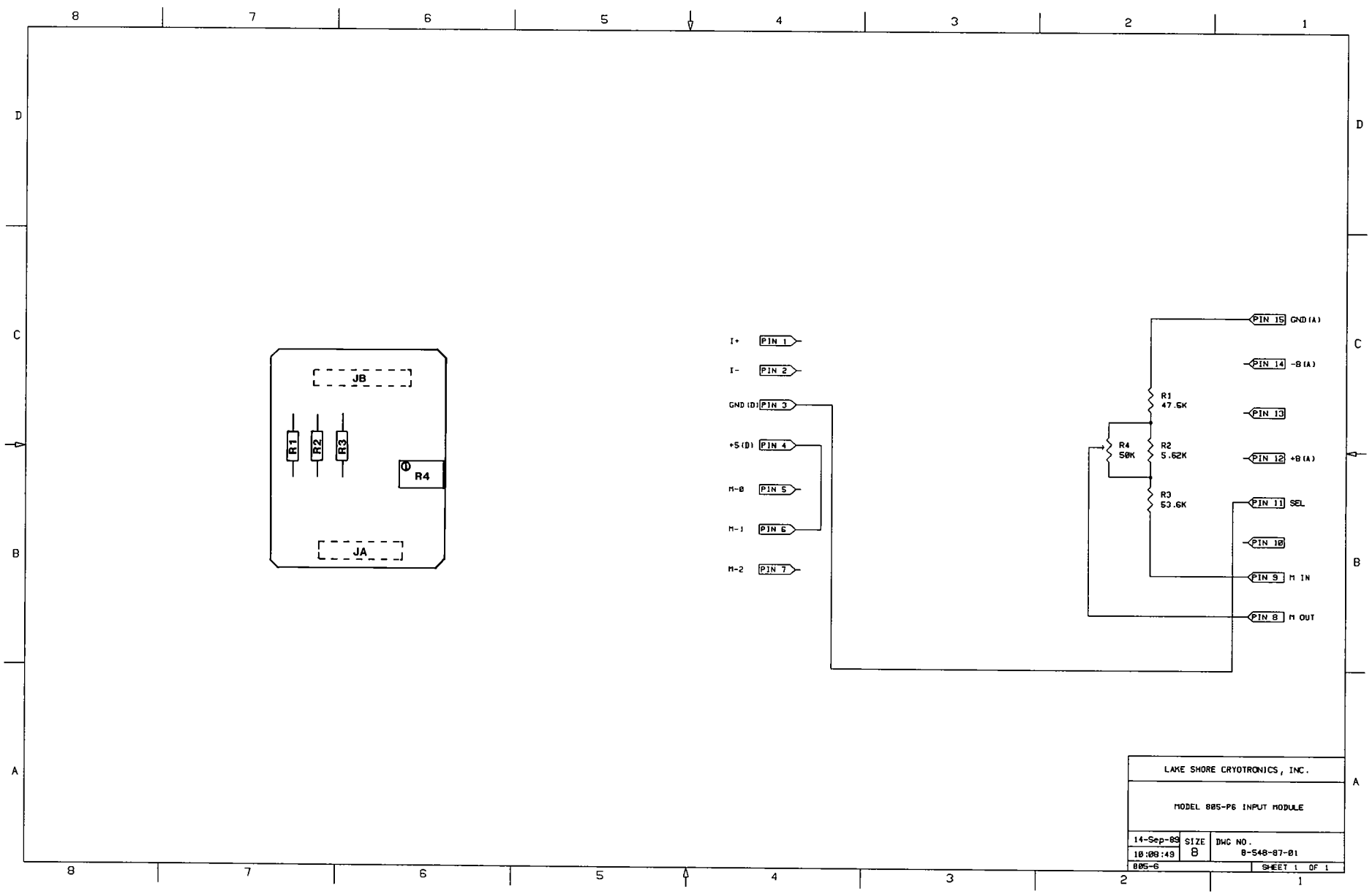
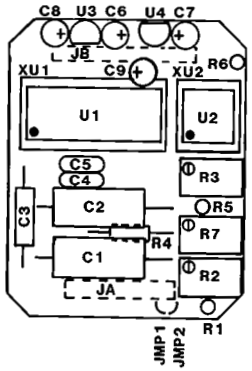
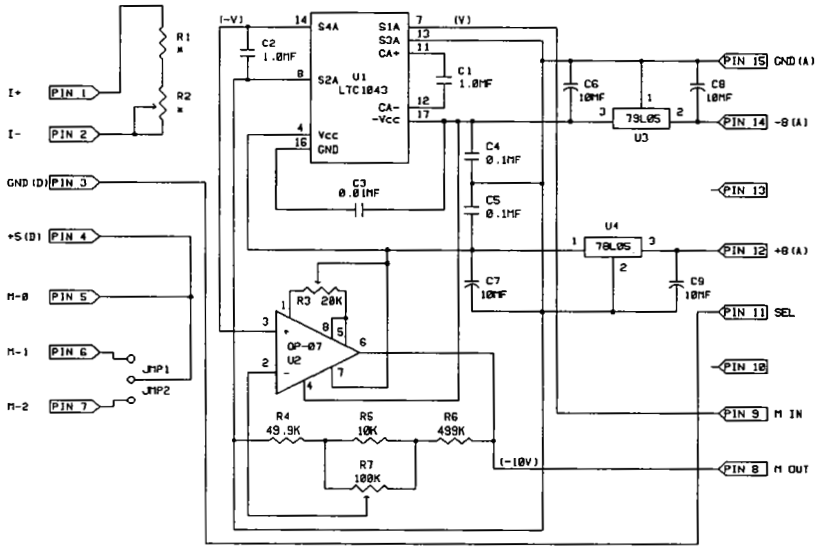

JB
R1
R2
R3
R4
JA
I+
PIN 1
I-
PIN 2
GND (D)
PIN 3
+5 (D)
PIN 4
M-0
PIN 5
M-1
PIN 6
M-2
PIN 7
PIN 15
GND (A)
PIN 14
-8 (A)
PIN 13
PIN 12
+8 (A)
PIN 11
SEL
PIN 10
PIN 9
M IN
PIN 8
M OUT
R1
47.5K
R4
50K
R2
5.62K
R3
53.6K
LAKE SHORE CRYOTRONICS, INC.
MODEL 805-P6 INPUT MODULE
14-Sep-89
10:00:49
SIZE
B
DWG NO.
8-548-87-01
805-G
SHEET 1 OF 1

REPLACEABLE PARTS LIST - 805-P2,-P3,-R1 CONVERSION MODULE

ITEM NO	LSCI Part Number	Qty	Description	MFR	MFR PART NO
U1	104-078	1	IC, SWITCHED CAPACITOR	LTC	LTC1043CN
U2	104-001	1	IC, OP AMP		OP07EP
U3	102-020	1	REGULATOR, -5V	MOT	UA79L05
U4	102-019	1	REGULATOR, +5V	MOT	UA78L05





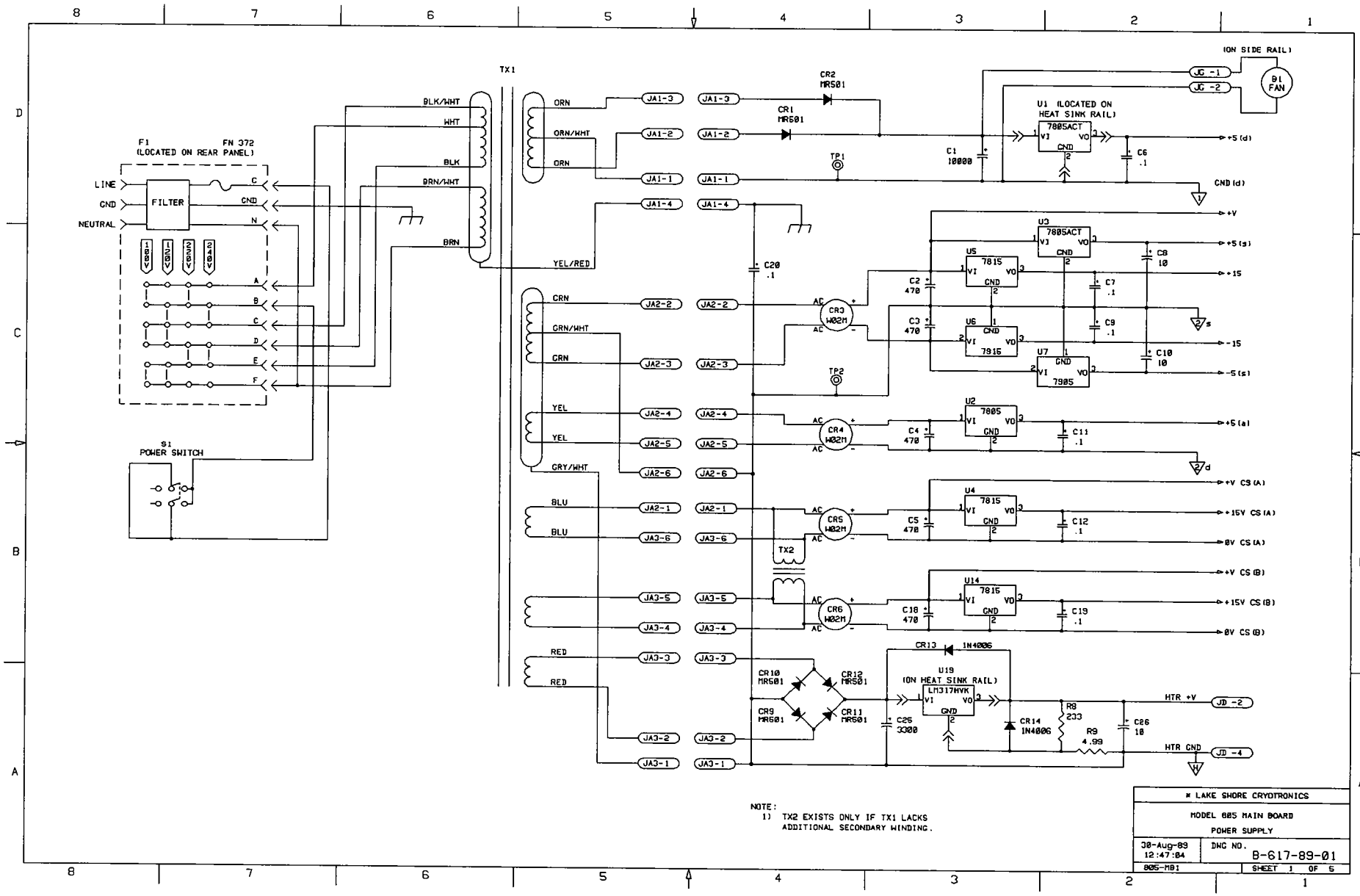
* MODULE	R1	R2	JMP
-P2	4.75K	500	-
-P3	53.6K	5K	2
-R1	1.50K	200	1

NOTE:
FOR 805-P3 MODULE CONNECT PIN 7 (M-2) TO PIN 4 (+5D). FOR 805-R1 MODULE CONNECT PIN 6 (M-1) TO PIN 4 (+5D).

LAKE SHORE CRYOTRONICS, INC.		
MODEL 805-P2 INPUT MODULE		
14-Sep-89	SIZE B	DWG NO. 8-549-87-01
10:14:23		
805P2		SHEET 1 OF 1

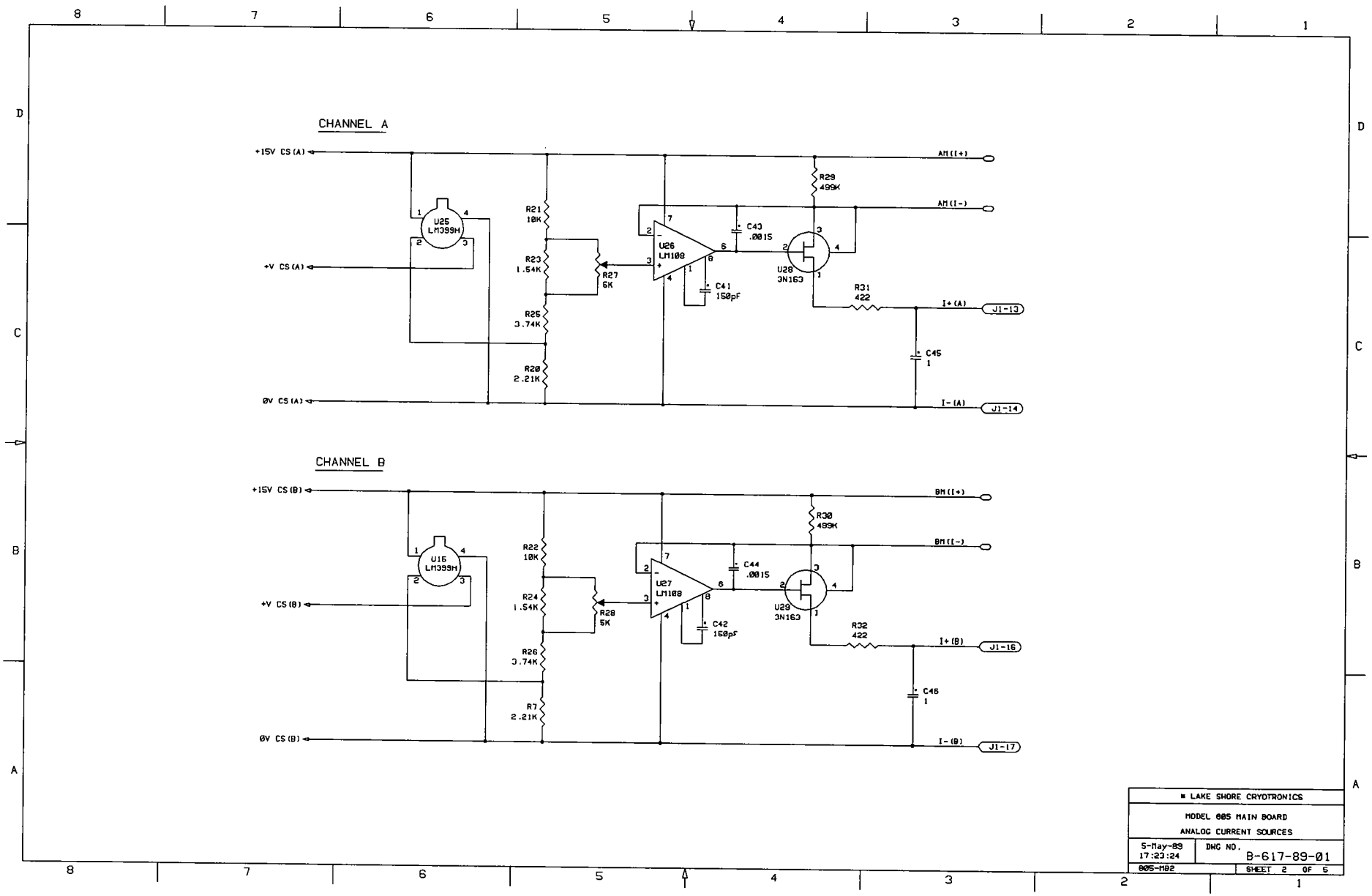
REPLACEABLE PARTS LIST - A1 MODEL 805 MAIN BOARD

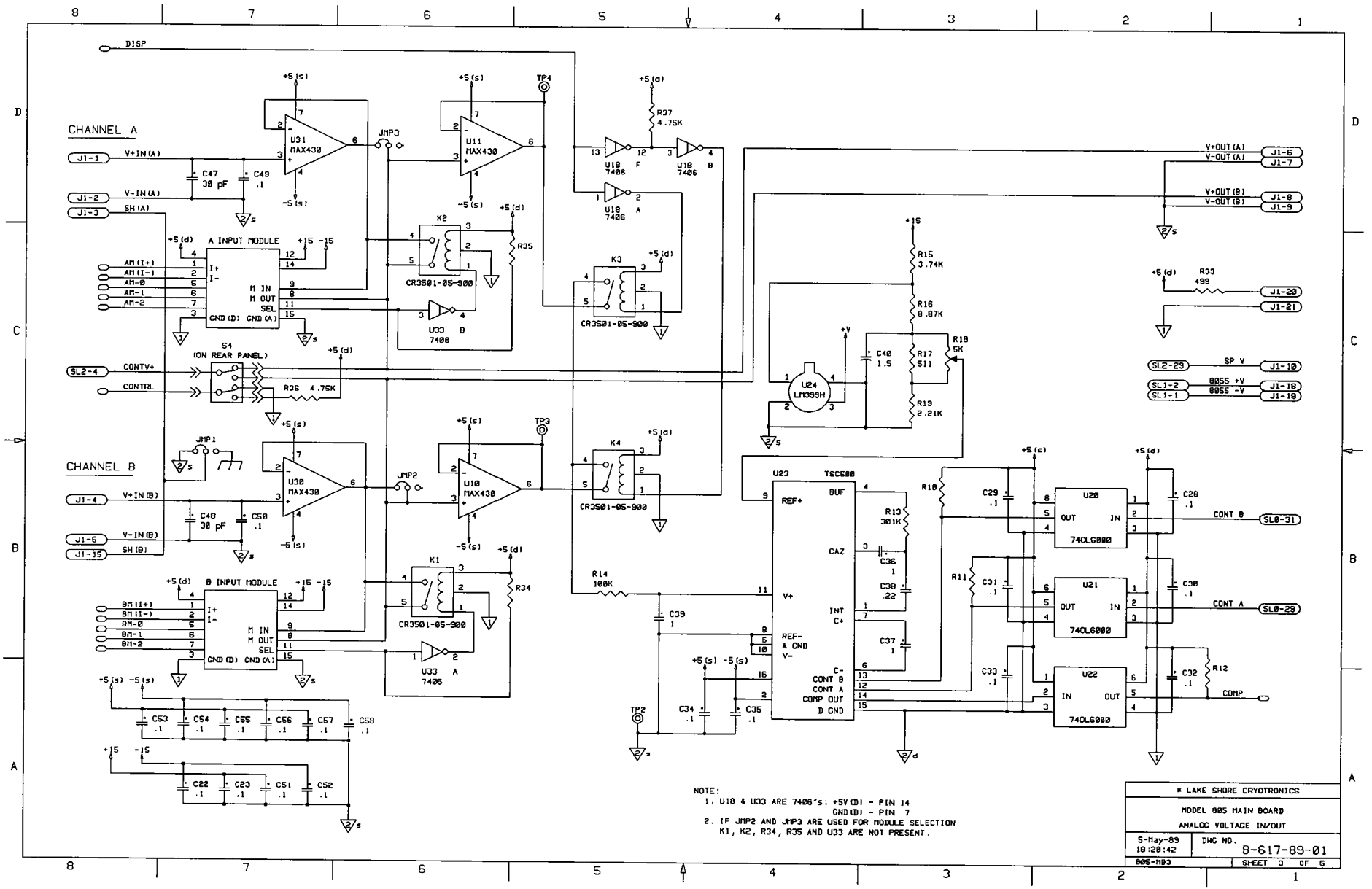
ITEM NO	LSCI PART NUMBER	QTY	DESCRIPTION	MFR	MFR PART NO
C1	101-285	1	CAP,ELECT,10000MF,25V	NUC	SM25T10000
C2-5,18	101-225	5	CAP,ELECT,470MF,35V	PAN	ECEAIVV471S
C25	101-245	1	CAP,ELECT,3300MF,50V	NUC	SM50T3300
C26	101-207	1	CAP,ELECT,10MF,100V	SPRG	30DTE1407
C36,37, 45,46	101-034	4	CAP,PP,1MF,100V	FDYNE	MPP2X-1.0-100-10
C38	101-023	1	CAP,PP,.22MF,100V	FDYNE	MPP11-.22-100-10
CR1,2, 9-12	102-003	6	DIODE RECTIFIER	MOT	MR501
CR3-6	102-008	4	BRIDGE RECTIFIER	IR	W02M
CR13,14	102-001	2	DIODE RECTIFIER	MOT	1N4006
J1	106-419	1	CONNECTOR (MB TO BP)	3M	3592-6002
JA1	106-139	1	CONNECTOR (MB TO TX1)	MOL	2630-09-74-1041
JA2	106-143	2	CONNECTOR (MB TO TX1)	MOL	2630-09-74-1061
JB,JC	106-427	2	CONNECTOR (MB TO DB)	3M	3593-6002
JE1,JF1	106-602	2	CONNECTOR (MB TO MOD.A/B)	SAMT	SSW-107-01-G-S
JE2,JF2	106-603	2	CONNECTOR (MB TO MOD.A/B)	SAMT	SSW-108-01-G-S
JG	106-706	1	LOCKING HEADER,2-PIN	MOL	22-29-2021
K1-4	105-323	4	RELAY, DRY REED	COTO	3501-05-9112
Q1	102-072	1	TRANSISTOR,PNP	MOT	2N3906
S1	105-014	1	POWER SWITCH (2 POLE)	ITT	F-01-2UEE/NE15
S2,3	105-408	2	SENSOR A ID (8 DIP SW)	GYH	76SB08
S4	105-404	1	INTERNAL ID (4 DIP SW)	GYH	76SB04
SP1-4	105-121	1	4 STATION THUMBWHEEL SW	EECO	4A216056GDA
SL0,1	106-229	2	CONNECTOR (25/50)	EDAC	342-050-520-202
SL2	106-227	1	CONNECTOR (18/36)	EDAC	342-036-520-202
U1-3	102-011	3	REGULATOR,+5V	MOT	MC7805ACT
U4	102-013	1	REGULATOR,+12V	NAT	LM7812CT
U5,14	102-014	2	REGULATOR,+15V	NAT	LM7815CT
U6	102-024	1	REGULATOR,-15V	NAT	LM7915CT
U7	102-021	1	REGULATOR,-5V	NAT	LM7905CT
U8,16	104-529	2	IC, PORT EXPANDER	NAT	82C55A-5
U9	104-526	1	IC, KEYBD INTERFACE	NAT	P8279-5
U10,11, 30,31	104-089	4	IC, OP AMP	MAX	MAX430CPA
U12	102-095	1	IC, POWER MOSFET (ON HSR)	IR	IRF9130
U13	104-310	1	IC, 8 BIT MULTIPLEXER	NAT	DM81LS95AN
U15,24, 25	102-043	3	VOLTAGE REFERENCE,6.95V	NAT	LM399H
U18,32	104-210	2	IC, HEX INVERTER,O.C.		7406
U19	102-036	1	IC, REGULATOR (ON HSR)	MOT	LM317HVK-STEEL
U20-22	104-355	3	IC, OPTOCOUPLER	GI	740L6000
U23	104-465	1	IC, A/D CONVERTER	TSC	TSC500CPE
U26,27	104-005	2	IC, OP AMP		LM308N
U28,29	102-074	2	MOSFET, P CHANNEL	SIL	3N163
W1		1	CABLE (MB TO U1 ON HSR)	LSCI	
XU12,19	106-571	2	SOCKET, TO-3		M8080-1G402

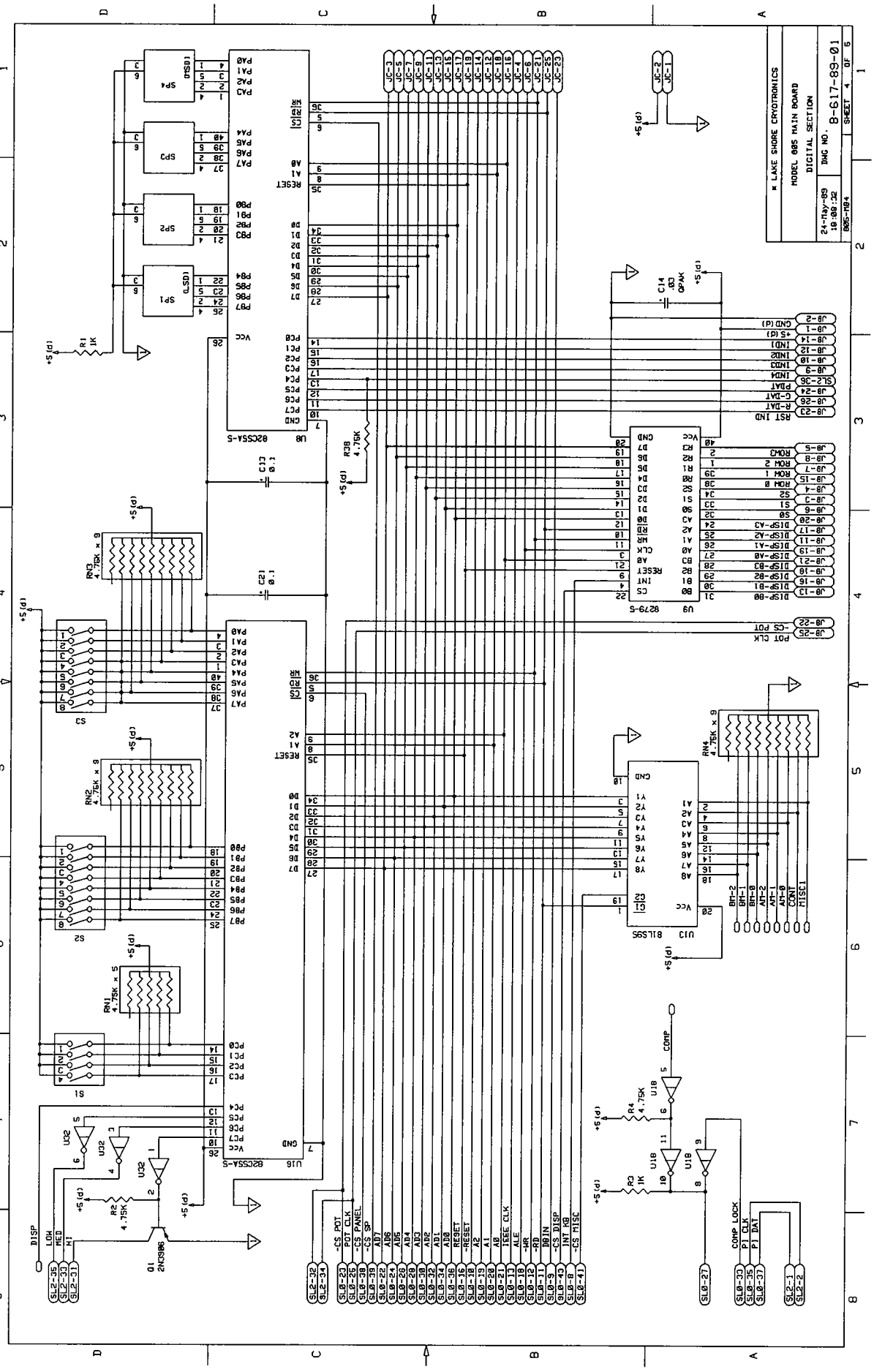


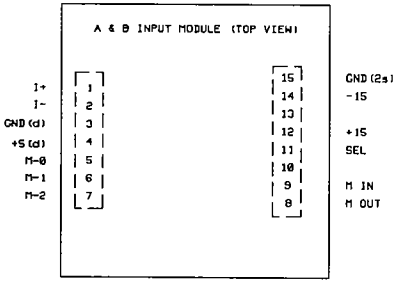
NOTE:
1) TX2 EXISTS ONLY IF TX1 LACKS ADDITIONAL SECONDARY WINDING.

* LAKE SHORE CRYOTRONICS	
MODEL 605 MAIN BOARD POWER SUPPLY	
30-Aug-89 12:47:04	DWG NO. B-617-89-01
605-M01	SHEET 1 OF 6


CHANNEL A
+15V CS(A)
+V CS(A)
0V CS(A)
U25
LM399H
R21
10K
R23
1.54K
R25
3.74K
R20
2.21K
R27
5K
U26
LM108
C41
150pF
C43
.0015
U28
3N163
R29
499K
R31
422
C45
1
AM(I+)
AM(I-)
I+(A)
J1-13
I-(A)
J1-14
CHANNEL B
+15V CS(B)
+V CS(B)
0V CS(B)
U15
LM399H
R22
10K
R24
1.54K
R26
3.74K
R7
2.21K
R28
5K
U27
LM108
C42
150pF
C44
.0015
U29
3N163
R30
499K
R32
422
C46
1
BM(I+)
BM(I-)
I+(B)
J1-16
I-(B)
J1-17
LAKE SHORE CRYOTRONICS
MODEL 805 MAIN BOARD
ANALOG CURRENT SOURCES
5-May-89
17:23:24
805-M02
DWG NO.
B-617-89-01
SHEET 2 OF 5


DISP
CHANNEL A
J1-1 V+IN(A)
J1-2 V-IN(A)
J1-3 SH(A)
U31 MAX430
U11 MAX430
JMP3
TP4
C47 30 pF
C49 .1
A INPUT MODULE
AM(I+)
AM(I-)
AM-0
AM-1
AM-2
M IN
M OUT
SEL
GND(D) GND(A)
K2
CR3S01-05-900
R35
U33 B 7406
K3
S4 (ON REAR PANEL)
SL2-4 CONTV+
CONTRL
R36 4.75K
CHANNEL B
JMP1
JMP2
J1-4 V+IN(B)
J1-5 V-IN(B)
J1-15 SH(B)
U30 MAX430
U10 MAX430
TP3
C48 30 pF
C50 .1
B INPUT MODULE
BM(I+)
BM(I-)
BM-0
BM-1
BM-2
K1
CR3S01-05-900
R34
U33 A 7406
K4
U18 7406 F
U18 7406 B
U18 7406 A
R37 4.75K
U24 LM399H
R15 3.74K
R16 8.87K
R17 511
R18 5K
R19 2.21K
C40 1.5
U23 TSC500
REF+
V+
REF-
A GND
V-
BUF
CAZ
INT
C+
C-
CONT B
CONT A
COMP OUT
D GND
R13 301K
R14 100K
C36 1
C38 .22
C37 1
C39 1
C34 .1
C35 .1
TP2
R10
R11
C29 .1
C31 .1
C33 .1
U20 74OL6000
U21 74OL6000
U22 74OL6000
C28 .1
C30 .1
C32 .1
R12
CONT B SL0-31
CONT A SL0-29
COMP
V+OUT(A) J1-6
V-OUT(A) J1-7
V+OUT(B) J1-8
V-OUT(B) J1-9
R33 499
J1-20
J1-21
SL2-29 SP V J1-10
SL1-2 8055 +V J1-18
SL1-1 8055 -V J1-19
C53 C54 C55 C56 C57 C58 .1
C22 C23 C51 C52 .1
NOTE:
1. U18 & U33 ARE 7406's: +5V(D) - PIN 14
GND(D) - PIN 7
2. IF JMP2 AND JMP3 ARE USED FOR MODULE SELECTION
K1, K2, R34, R35 AND U33 ARE NOT PRESENT.
LAKE SHORE CRYOTRONICS
MODEL 805 MAIN BOARD
ANALOG VOLTAGE IN/OUT
5-May-89 10:20:42
DWG NO. 8-617-89-01
805-M03
SHEET 3 OF 6


LAKE SHORE CRYOTRONICS
MODEL 805 MAIN BOARD
DIGITAL SECTION
24-May-89
18:38:32
DWG NO. 8-617-89-01
805-M84
SHEET 4 OF 6
U8 82C55A-S
U16 82C55A-S
U9 8279-S
U13 81LS95
U18
U32
RN1 4.75K x 5
RN2 4.75K x 9
RN3 4.75K x 9
RN4 4.75K x 9
S1
S2
S3
SP1 (DSW)
SP2
SP3
SP4 (DSW)
R1 1K
R2 4.75K
R3 1K
R4 4.75K
R38 4.75K
C13 0.1
C21 0.1
C14 .03 DPAK
Q1 2N3906
+5(d)
GND
RESET
DISP
LDH
HEB
HI
COMP
COMP LOCK
P1 CLK
P1 DAT
-CS POT
POT CLK
-CS PANEL
-CS SP
ADT
ADB
ADS
ADC
ADD
RESET
-RESET
A2
A1
A0
ISBE CLK
ALE
-WR
-RD
DBIN
-CS DISP
INT KB
-CS MISC
-CS POT
POT CLK
RST IND
R-DAT
G-DAT
P1DAT
CONT
MISC1



J1
SENSOR & MONITORS CONNECTOR

V+IN (A)	1	13	I+ (A)
V-IN (A)	2	14	I- (A)
SH (A)	3	15	SH (B)
V+IN (B)	4	16	I+ (B)
V-IN (B)	5	17	I- (B)
V+OUT (A)	6	18	8055 +V
V-OUT (A)	7	19	8055 -V
V+OUT (B)	8	20	+5 (d)
V-OUT (B)	9	21	GND (d)
SP V	10	22	

JC
OPTION CONNECTOR (8053 OR 8054)

GND (d)	1	2	+5 (d)
AD7	3	4	IEEE CLK
AD6	5	6	ALE
AD5	7	8	INT0
AD4	9	10	INT OPT2
AD3	11	12	A2
AD2	13	14	RESET
AD1	15	16	A0
AD0	17	18	A1
RESET	19	20	-CS IEEE ADD
-WR	21	22	-CS IEEE
DBIN	23	24	-CS 4
-RD	25	26	-CS OPT2

J8
DISPLAY BOARD CONNECTOR

+5 (d)	1	2	GND (d)
S1	3	4	S2
ROW 3	5	6	S0
ROW 1	7	8	ROW 2
IND4	9	10	IND3
DISP-A1	11	12	IND2
DISP-B0	13	14	IND1
ROW 0	15	16	DISP-B1
DISP-A2	17	18	DISP-B2
DISP-A0	19	20	DISP-A3
DISP-B3	21	22	-CS POT
RST IND	23	24	G-DAT
POT CLK	25	26	R-DAT

SLOT 2
ANALOG CONTROL CARD

PI DAT	1	2	PI CLK
+5 (d)	3	4	CONT V+
GND (d)	5	6	GND (d)
+15	7	8	+15
-15	9	10	-15
-5 (s)	11	12	-5 (s)
GND (2s)	13	14	GND (2s)
GND (2s)	15	16	GND (2s)
+5 (s)	17	18	+5 (s)
+5 (a)	19	20	+5 (a)
GND (2d)	21	22	GND (2d)
GND (2d)	23	24	GND (2d)
	25	26	
	27	28	
	29	30	
HI	31	32	-CS POT
MED	33	34	POT CLK
LOW	35	36	PDAT

SLOT 1
OPTION SLOT (8055)

8055 -V	1	2	8055 +V
	3	4	
	5	6	
INT-OPT1	7	8	
DBIN	9	10	-RESET
-RD	11	12	-WR
	13	14	
	15	16	RESET
	17	18	ALE
A2	19	20	A1
A0	21	22	AD7
	23	24	AD6
OPT1-ID	25	26	AD5
	27	28	AD4
	29	30	AD3
	31	32	AD2
	33	34	AD1
	35	36	AD0
	37	38	
	39	40	
	41	42	+5 (d)
-CS 6	43	44	
-CS OPT1	45	46	GND (d)
	47	48	
	49	50	

SLOT 0
MICROPROCESSOR AND MEMORY CARD

	1	2	
OPT1-ID	3	4	
	5	6	INT-OP2
INT-OPT1	7	8	INT-KB
DBIN	9	10	-RESET
-RD	11	12	-WR
IEEE CLK	13	14	
	15	16	RESET
-INT0	17	18	ALE
A2	19	20	A1
A0	21	22	AD7
-CS POT	23	24	AD6
POT CLK	25	26	AD5
COMP IN	27	28	AD4
CONT A	29	30	AD3
CONT B	31	32	AD2
COMP LOCK	33	34	AD1
PI CLK	35	36	AD0
PI DAT	37	38	-CS PANEL
-CS SP	39	40	-CS IEEE ADD
-CS MISC	41	42	-CS 6
-CS DISP	43	44	-CS 4
-CS OPT1	45	46	-CS OPT2
	47	48	-CS IEEE
+5 (d)	49	50	GND (d)

LAKE SHORE CRYOTRONICS

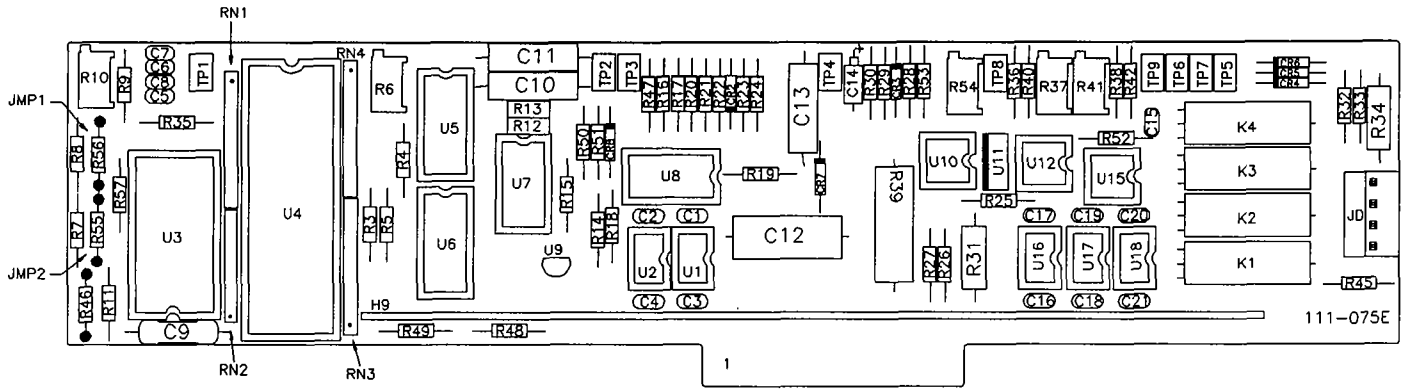
MODEL 805 MAIN BOARD
SLOT INTERCONNECTIONS

24-May-89 17:57:21

DWG NO. 8-617-89-01

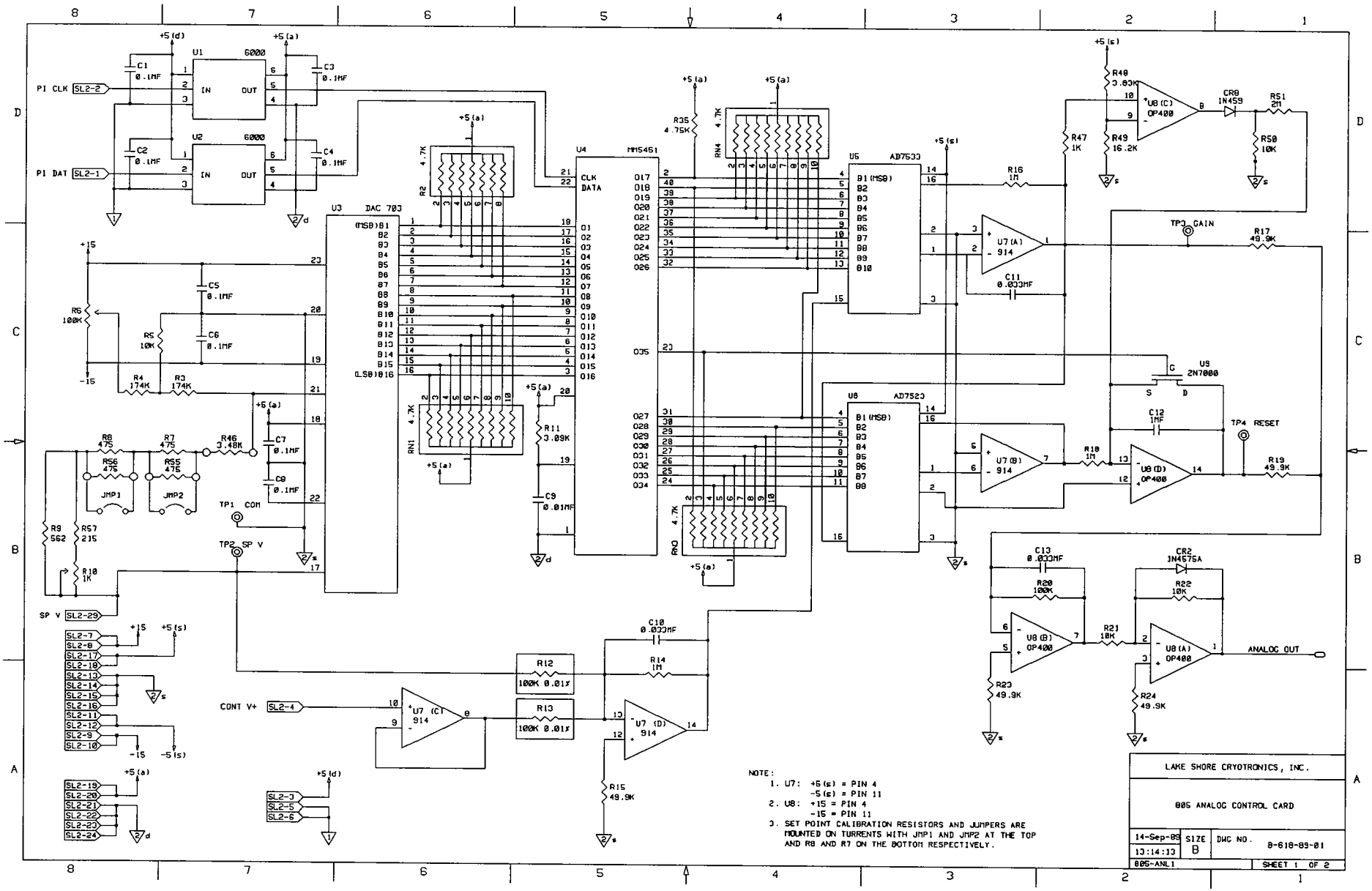
805-MBS

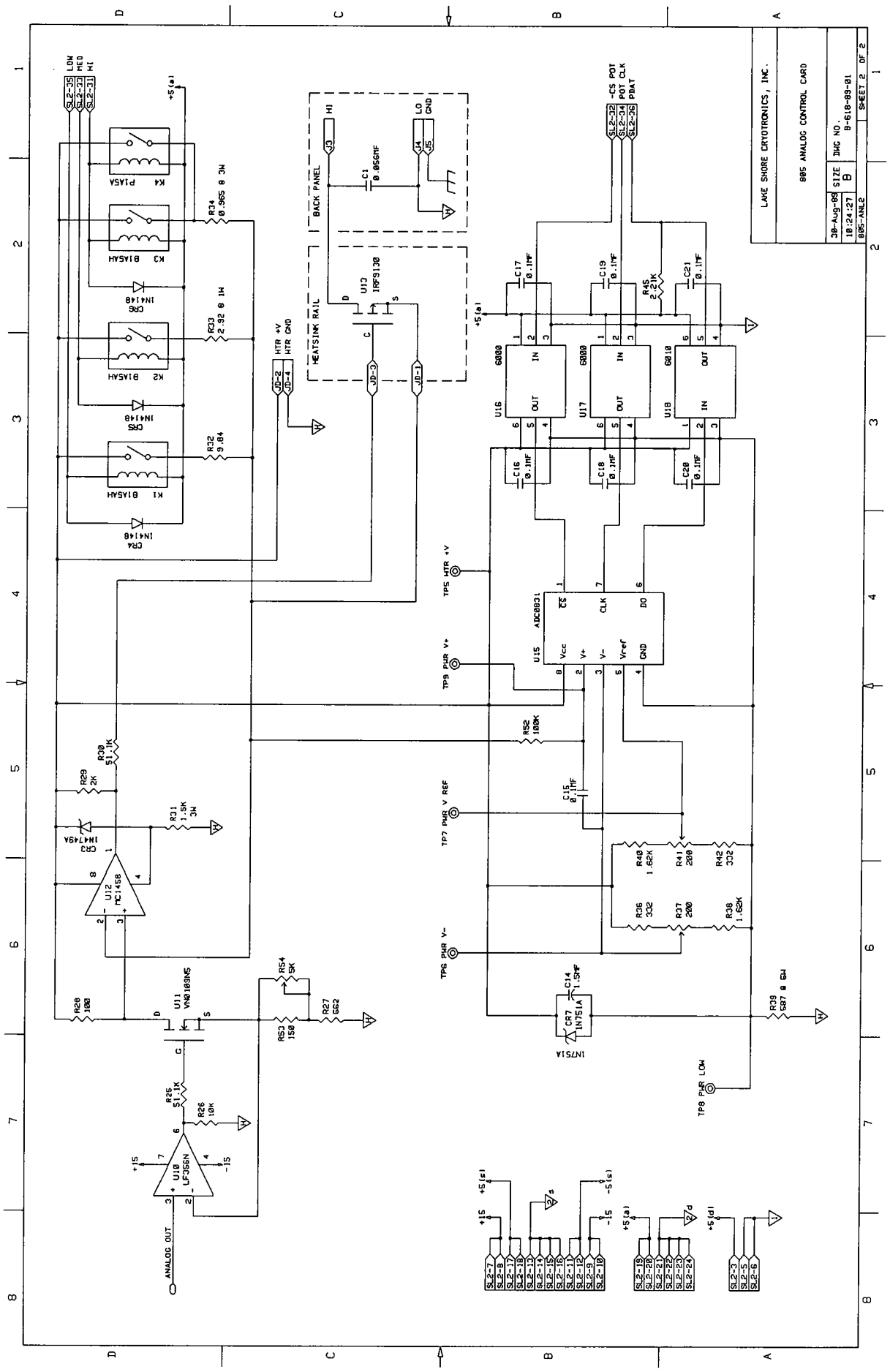
SHEET 5 OF 6

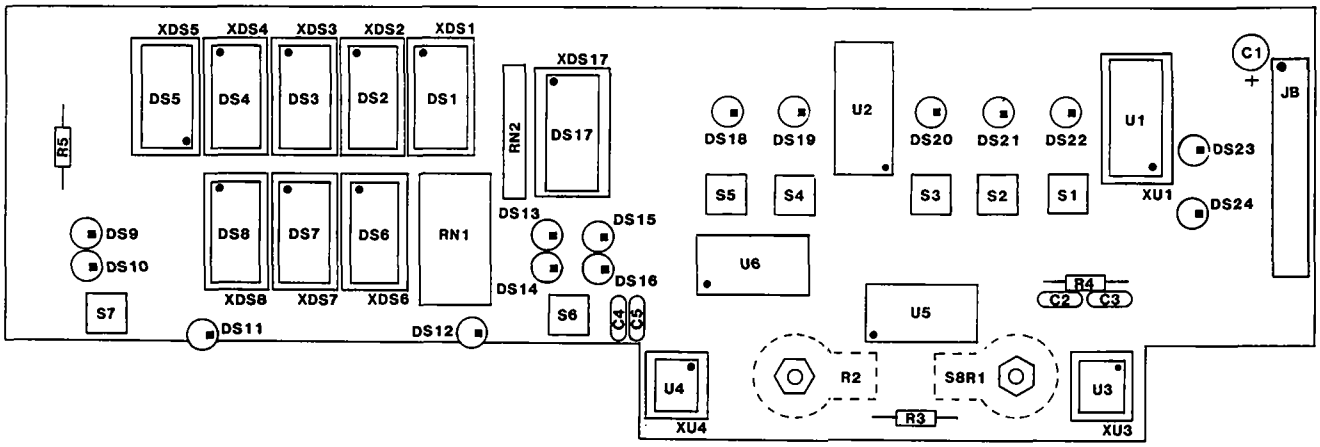


REPLACEABLE PARTS LIST - A6 ANALOG CONTROL CARD

ITEM NO	LSCI PART NUMBER	QTY	DESCRIPTION	MFR	MFR PART NUMBER
CR3	102-058	1	DIODE, ZENER, 24V		1N4749A
CR7	102-053	1	DIODE, ZENNER, 5.1V		1N751A
JD	106-139	1	4 POST LOCKING HEADER	MOL	2630-09-74-1041
K1-3	105-302	3	RELAY, SPST, 20W	EAC	B1A5H
K4	105-304	1	RELAY, SPST, 50W	EAC	P1A5H
R12,13	103-063	1	RES, PREC, 100K, .01%	LSCI	
R31	103-628	1	RES, WWD, 1.5K, 3W, 1%		
R32	103-495	1	RES, WWD, 9.84K, 1/4W, 1%		
R33	103-540	1	RES, WWD, 2.92K, 1W, 1%		
R34	103-581	1	RES, WWD, 0.965, 3W, 1%		
R39	103-675	1	RES, WWD, 587, 5W, 1%		
U1,2 16,17	104-355	4	IC, OPTOCOUPLER	GI	74OL6000
U3	104-419	1	IC, 16 BIT D/A CONVERTER	BB	DAC703 BH-5
U4	104-162	1	IC, DISPLAY DRIVER	NAT	MM5451
U5	104-408	1	IC, 10 BIT D/A CONVERTER	ISL	AD7533JN
U6	104-404	1	IC, 8 BIT D/A CONVERTER	ISL	AD7523JN
U7,8	104-088	2	IC, OP AMP, QUAD	TSC	TSC914D
U9	104-076	1	IC, DUAL SPDT ANL SWITCH	HAR	HI5043-5
U10	104-022	1	IC, OP AMP, JFET INPUT		LF356N
U11	102-104	1	POWER MOSFET, 90V, P CHAN	SPTX	VN0109N5
U12	104-068	1	IC, OP AMP, DUAL, MC1741		MC1458PI
U15	104-453	1	IC, 8 BIT D/A CONVERTER	NAT	ADC0831CCN
U18	104-356	1	IC, OPTOCOUPLER	GI	74OL6010

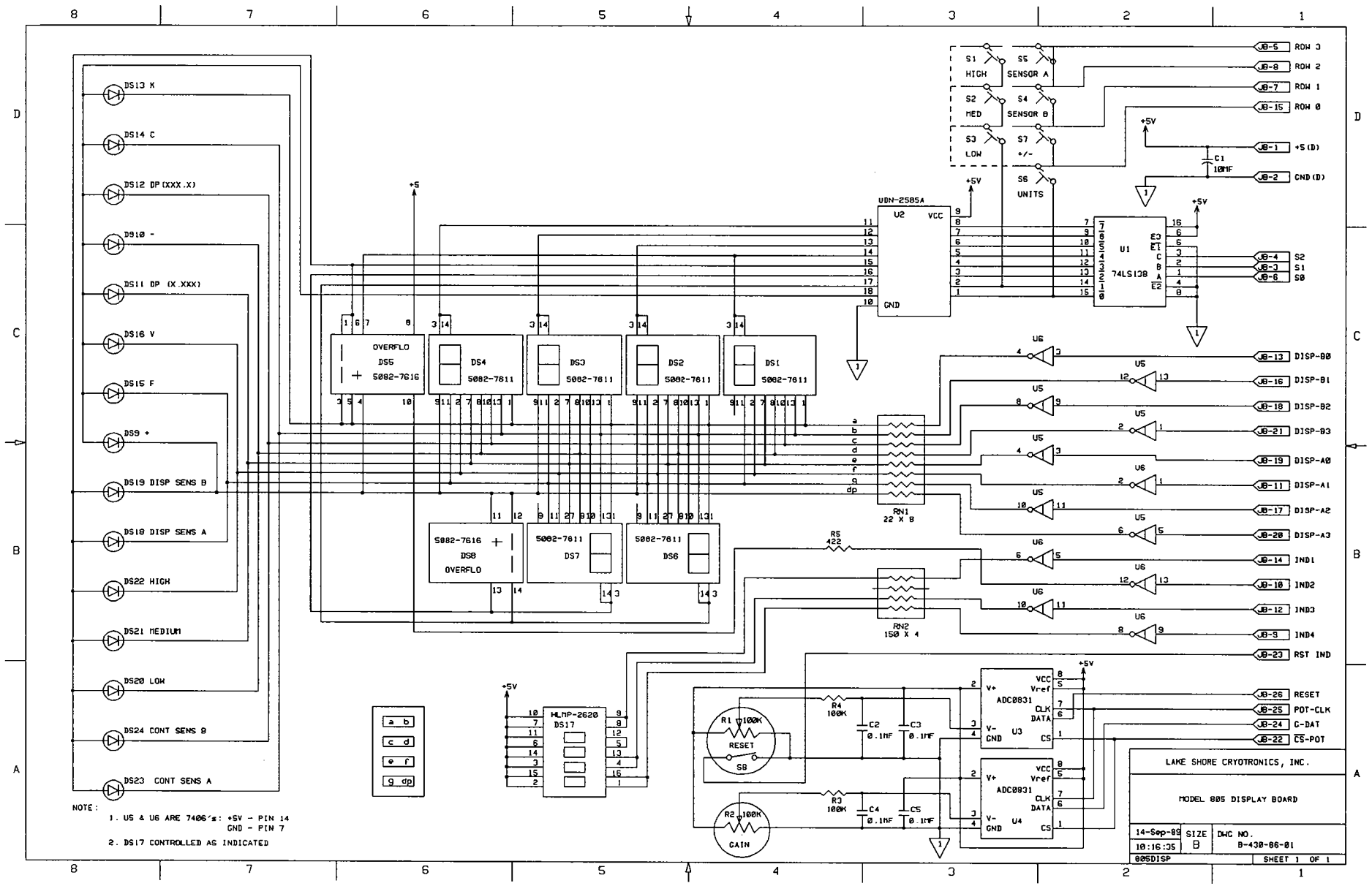

PI CLK SL2-2
PI DAT SL2-1
U1 6000
U2 6000
U3 DAC 703
U4 MM5451
U5 AD7533
U6 AD7533
U7 (A) 914
U7 (B) 914
U7 (C) 914
U7 (D) 914
U8 (A) OP400
U8 (B) OP400
U8 (C) OP400
U8 (D) OP400
U9 2N7000
CR1 1N4575A
CR2 1N4575A
CR8 1N459
TP1 COM
TP2 SP V
TP3 GAIN
TP4 RESET
SP V SL2-29
CONT V+ SL2-4
ANALOG OUT
JMP1
JMP2
NOTE:
1. U7: +5(s) = PIN 4
-5(s) = PIN 11
2. U8: +15 = PIN 4
-15 = PIN 11
3. SET POINT CALIBRATION RESISTORS AND JUMPERS ARE MOUNTED ON TURRENTS WITH JMP1 AND JMP2 AT THE TOP AND R8 AND R7 ON THE BOTTOM RESPECTIVELY.
LAKE SHORE CRYOTRONICS, INC.
805 ANALOG CONTROL CARD
14-Sep-89
13:14:13
805-ANL1
SIZE B
DWG NO. 8-618-89-01
SHEET 1 OF 2

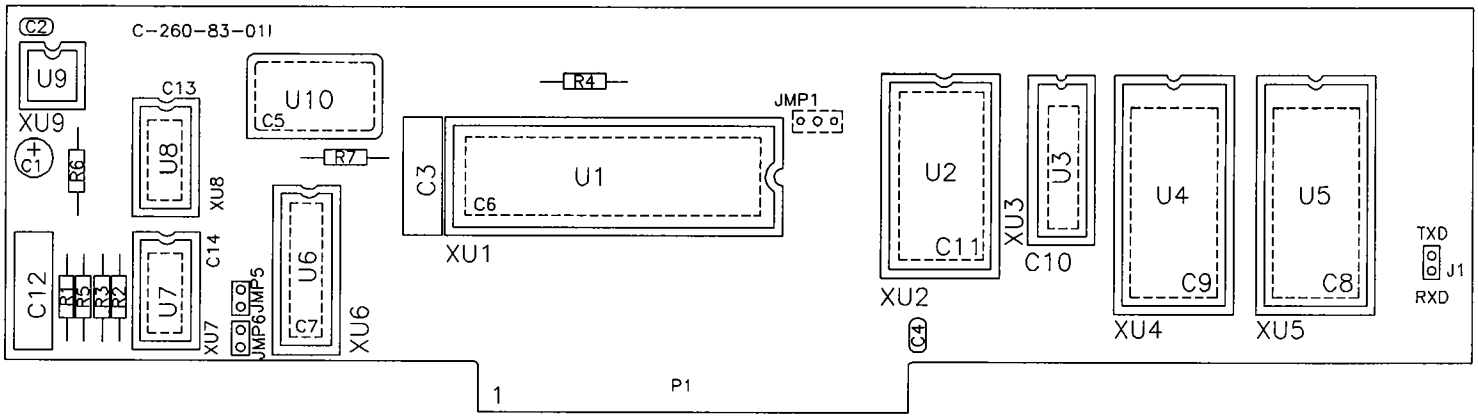

LAKE SHORE CRYOTRONICS, INC.
805 ANALOG CONTROL CARD
30-Aug-89 10:24:27
805-ANL2
SIZE B
DWG NO. 8-618-89-01
SHEET 2 OF 2
SL2-35 LOW
SL2-33 MED
SL2-31 HI
+5(a)
K4 P1A5A
K3 B1A5AH
K2 B1A5AH
K1 B1A5AH
R34 0.965 @ 3W
R33 2.92 @ 1W
R32 9.84
CR6 IN4148
CR5 IN4148
CR4 IN4148
HTR +V
HTR GND
JD-2
JD-4
JD-3
JD-1
HEATSINK RAIL
BACK PANEL
J3 HI
J4 LO
J5 GND
C1 0.056MF
U13 IRF9130
SL2-32 -CS POT
SL2-34 POT CLK
SL2-36 PDAT
C17 0.1MF
C19 0.1MF
C21 0.1MF
R45 2.21K
U16 6000 IN OUT
U17 6000 IN OUT
U18 6010 OUT IN
C16 0.1MF
C18 0.1MF
C20 0.1MF
U15 ADC0831 CS CLK DO Vcc V+ V- Vr-ef GND
TP5 HTR +V
TP9 PWR V+
TP7 PWR V REF
TP6 PWR V-
TP8 PWR LOW
R52 100K
C15 0.1MF
R40 1.62K
R41 200
R42 332
R36 332
R37 200
R38 1.62K
R30 51.1K
R29 2K
R31 1.5K 3W
CR3 IN4749A
U12 MC1458
R28 100
U11 VN0109N5
R54 5K
R27 562
R53 150
C14 1.5MF
CR7 IN751A
R39 587 @ 5W
R25 51.1K
R26 10K
U10 LF356N
+15
-15
ANALOG OUT
+5(s)
-5(s)
+5(a)
+5(d)
SL2-7 SL2-8 SL2-17 SL2-18 SL2-13 SL2-14 SL2-15 SL2-16 SL2-11 SL2-12 SL2-9 SL2-10
SL2-19 SL2-20 SL2-21 SL2-22 SL2-23 SL2-24
SL2-3 SL2-5 SL2-6



REPLACEABLE PARTS LIST - 805 DISPLAY BOARD

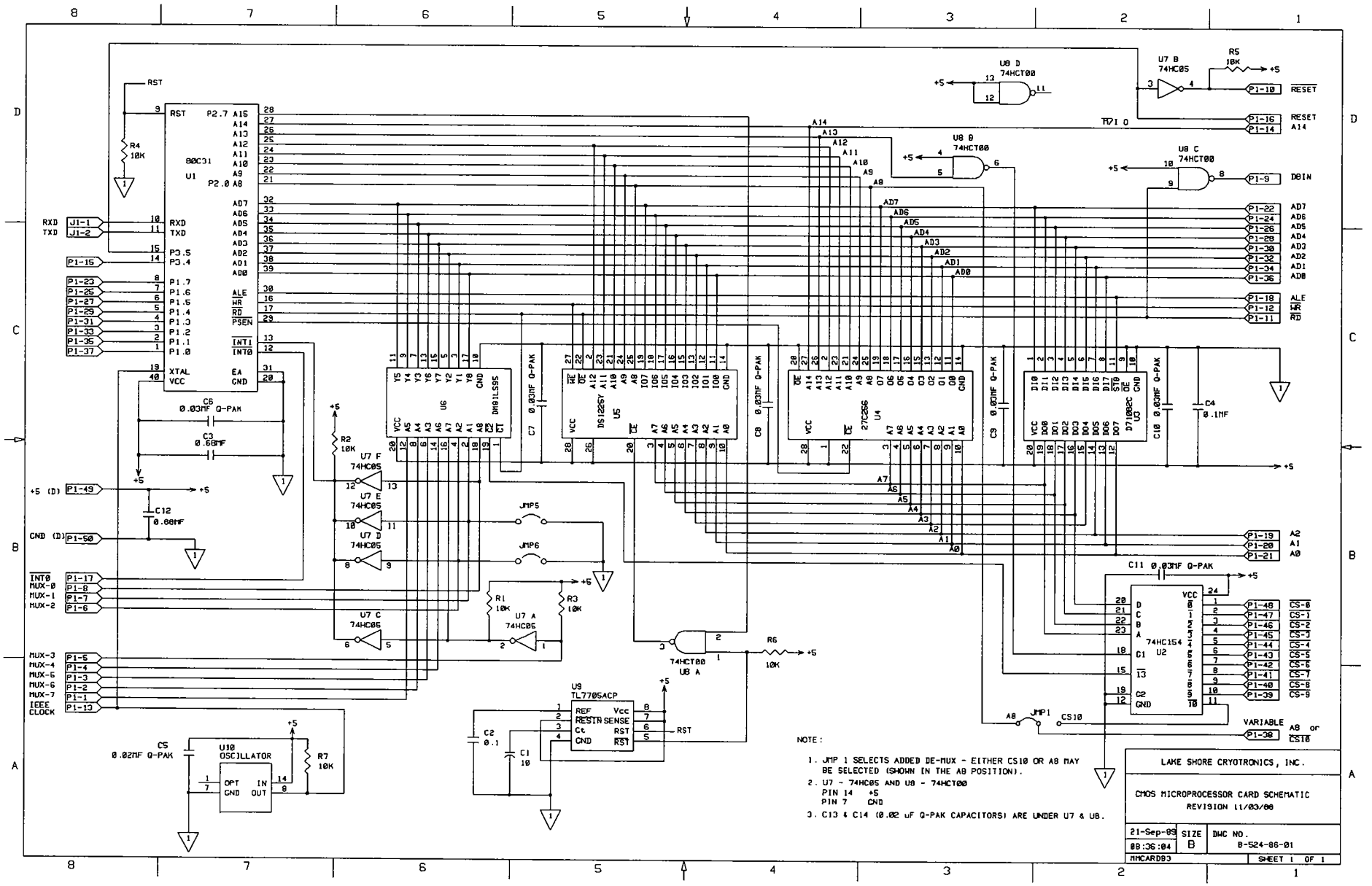
ITEM NO	LSCI Part Number	Qty	Description	MFR	MFR PART NO
JB		1	CABLE (MB TO DB)	LSCI	
R1/S8	105-146	1	SWITCH POT, 100K,CCW DET	CENT	BA12030018
R2	105-145	1	POT, 100K	CENT	BA12010043
S1-7	105-651	7	SWITCH	ALPS	KEF 10901
U1	104-261	1	IC, 3-8 LINE DECODER		74LS138
U2	104-160	1	IC, TRANSISTOR DRIVER	SPRG	UDN-2585A
U3,4	104-453	2	IC, 8 BIT A/D CONVERTER	NAT	ADC0831CCN
U5,6	104-210	2	IC, INVERTER, O.C.		7406


DS13 K
DS14 C
DS12 DP(XXX.X)
DS10 -
DS11 DP (X.XXX)
DS16 V
DS15 F
DS9 +
DS19 DISP SENS B
DS18 DISP SENS A
DS22 HIGH
DS21 MEDIUM
DS20 LOW
DS24 CONT SENS B
DS23 CONT SENS A
S1 HIGH
S2 MED
S3 LOW
S5 SENSOR A
S4 SENSOR B
S7 +/-
S6 UNITS
C1 10MF
U2 VCC
GND
ULN-2585A
U1 74LS138
OVERFLO DS5 5082-7616
DS4 5082-7811
DS3 5082-7811
DS2 5082-7811
DS1 5082-7811
5082-7616 DS8 OVERFLO
5082-7811 DS7
5082-7811 DS6
RN1 22 X 8
RN2 150 X 4
R5 422
HLMP-2620 DS17
R1 100K RESET S8
R2 100K GAIN
R3 100K
R4 100K
C2 0.1MF
C3 0.1MF
C4 0.1MF
C5 0.1MF
ADC0831 U3
ADC0831 U4
J8-5 ROW 3
J8-8 ROW 2
J8-7 ROW 1
J8-15 ROW 0
J8-1 +5(D)
J8-2 GND(D)
J8-4 S2
J8-3 S1
J8-6 S0
J8-13 DISP-B0
J8-16 DISP-B1
J8-18 DISP-B2
J8-21 DISP-B3
J8-19 DISP-A0
J8-11 DISP-A1
J8-17 DISP-A2
J8-20 DISP-A3
J8-14 IND1
J8-10 IND2
J8-12 IND3
J8-9 IND4
J8-23 RST IND
J8-26 RESET
J8-25 POT-CLK
J8-24 C-DAT
J8-22 CS-POT
NOTE:
1. U5 & U6 ARE 7406's: +5V - PIN 14
GND - PIN 7
2. DS17 CONTROLLED AS INDICATED
LAKE SHORE CRYOTRONICS, INC.
MODEL 805 DISPLAY BOARD
14-Sep-89
10:16:35
805DISP
SIZE B
DWG NO. B-430-86-01
SHEET 1 OF 1



REPLACEABLE PARTS LIST - A5 MICROPROCESSOR CARD

ITEM NO	LSCI PART NUMBER	QTY	DESCRIPTION	MFR	MFR PART NO
C1	101-137	1	CAP,TANT,10MF,35V	SPRG	119D106X0035DB1
U1	104-511	1	IC,MICROPROCESSOR	INT	P80C31
U2	104-276	1	IC,4-16 LINE DECODER		74HC154
U3	104-528	1	IC,8 BIT LATCH	NEC	UPD71082C
U4	104-661	1	IC,EPROM(PROGRAM)	INT	27C256
U5	104-653	1	IC,8Kx8 NOVRAM	DAL	DS1225Y
U6	104-310	1	IC,8 BIT MULTIPLEXER	NAT	DM81LS95
U7	104-209	1	IC,O.D. HEX INVERTER		74HCO5N
U8	104-201	1	IC,QUAD,DUAL INPUT NAND		74HCT00
U9	104-775	1	IC,VOLTAGE SUPERVISOR	TI	TL7705ACP
U10	104-750	1	IC,5.OMHZ OSCILLATOR		


LAKE SHORE CRYOTRONICS, INC.
CMOS MICROPROCESSOR CARD SCHEMATIC
REVISION 11/03/00
21-Sep-09
08:36:04
SIZE B
DWG NO. 8-524-86-01
MMCARD03
SHEET 1 OF 1
NOTE:
1. JMP 1 SELECTS ADDED DE-MUX - EITHER CS10 OR A8 MAY BE SELECTED (SHOWN IN THE A8 POSITION).
2. U7 - 74HC05 AND U8 - 74HCT00
PIN 14 +5
PIN 7 GND
3. C13 & C14 (0.02 uF Q-PAK CAPACITORS) ARE UNDER U7 & U8.

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MODEL 8053 RS-232C INTERFACE

8053.1 INTRODUCTION

This Section contains information pertaining to the Model 8053 RS-232C Interface for the Model 805 Temperature Controller. Included is a description, specifications, installation, operation and maintenance information.

8053.2 DESCRIPTION

The 8053 RS-232C Interface is designed to be installed in a Model 805 and provide an interface with an external RS-232C instrument such as a computer, modem or CRT. The interface operates in a half duplex mode (it can only transmit and receive information in one direction at a time) and data transmission is asynchronous (each character is bracketed by start and stop bits that separate and synchronize the transmission and receipt of data). The baud rate is switch selectable at 300 or 1200 baud and the interface maintains EIA voltage levels for data transmission.

Figure 8053-2 gives a transmission format which shows the data bits framed by the start and stop synchronization bits. The data is transmitted using two voltage levels which represent the two binary states of the digit. A logic 0 (or SPACE) is +3 to +12 VDC. A logic 1 (or MARK) is -3 to -12 VDC. When data is not being transmitted, the line is held low (MARK state). When the transmission device is ready to send data, it takes the line to the high (SPACE) state for the time of one bit. This transition is called the start bit. The remaining data is then transmitted. If a parity bit is used, it follows the character. The parity bit is determined by the number of 1 bits in the character. Refer to Table 8053-1 for parity determination.

Table 8053-1. Parity Determination

Number of "1"s in character	Parity Specified	Parity Bit
Odd	Odd	0
Even	Odd	1
Odd	Even	1
Even	Even	0

The Model 8053 RS-232C Interface has a 25 pin D style connector located on the rear panel. Pin Assignments are shown in Table 8053-2.

Table 8053-2. Connector Pin Assignments for RS-232C

Pin	Description	Signal
1	Protective Ground	AA
2	Transmitted Data	BA
3	Received Data	BB
4	Request to Send	CA
5	Clear to Send	CB
6	Data Set Ready	CC
7	Signal Ground	AB
8	Rcvd Ln Sgnl Dtctr	CF
20	Data Terminal Rdy	CD

The RS-232C signals are used in the following manner:

Protective Ground (AA) - conductor is taken to case ground potential and is common with the signal ground (AB).

Transmitted Data (BA) - transmits data using the EIA voltage levels (+8V and -8V).

Received Data (BB) - accepts data using EIA voltage levels.

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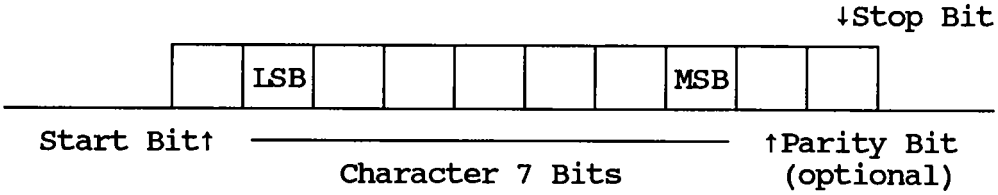
Figure 8053-2. Word Structure



Request to Send (CA) - indicates to the host computer or terminal that the Model 805 Interface is ready to transmit data. The Interface transmits data on line BA when the "ON" state is maintained on CC, CB and CF, while a low level on these lines inhibits transmission by the Interface.

Clear to Send (CB) - indicates to the Interface that data transmission is allowed. Internally pulled up to maintain "ON" state when left disconnected.

Data Set Ready (CC) - indicates to the Interface that the host computer or terminal is not in a test mode and that power is ON.

Signal Ground (AB) - this line is the common signal connection for the Interface.

Received Line Signal Detector (CF) - this line is held positive ("ON") when the Interface is receiving signals from the host computer. When held low ("OFF") the BB line is clamped to inhibit data reception. Internally pulled up to maintain "ON" state when left disconnected.

Data Terminal Ready (CD) - asserted by the Interface whenever the 805/8053 power is "ON" to indicate that the Interface is ready to receive and transmit data.

8053.3 Configuration of Dip Switches

8053.3.1 Selection of Baud Rate

The Model 8053 has a field selectable baud rate using DIP switch package S1, switches 7 (300 Baud) and 8 (1200 Baud). The Baud rate is selected by closing the switch position for the desired baud rate and making sure the other position is open.

8053.3.2 Word Structure Selection

The word structure is determined by switch settings for character length, parity and stop bits using DIP switch package S1 (Switches 1-6) on the Interface Card. Refer to Table 8053-3 for settings where "0" is OPEN and "1" is CLOSED.

8053.4 SPECIFICATIONS

Specifications for the Model 8053 RS-232C Interface are given in Table 8053-4.

8053.5 INSTALLATION

The 8053 RS-232C Interface is factory installed if ordered with a Model 805 Temperature Controller or can be field installed at a later date. If field installation is required, use the following procedure.

1. Configure the 8053 baud rate and word structure switches as outlined in Section 8053.3.

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Table 8223-3. Word Structure

Switch S1 1 2 3 4 5 6	Word Structure Choices
0 0 X X X X	Stop Bits Invalid
0 1 X X X X	1 Bit
1 0 X X X X	1½ (not supported)
1 1 X X X X	2 Bits
X X 1 X X X	Parity Genertn/Chck Even
X X 0 X X X	Odd
X X X 1 X X	Parity Enable Enable
X X X 0 X X	Disable
X X X X 0 0	Character Length Bits 5 (not supported)
X X X X 0 1	6 (not supported)
X X X X 1 0	7 (Supported)
X X X X 1 1	8 (not supported)

Table 8053-4. Model 8053 RS-232C Interface Specifications

Timing Format - Asynchronous
Transmission Mode - Half Duplex
Baud Rate - 300 or 1200 Bits/sec (Factory set to 300)
Bits per Character - 7(excluding start, stop or parity bits)
Parity Enable - Enabled/Disabled (Factory set Enabled)
Parity Select - Odd or Even (Factory set Odd)
Number of Stop Bits - 1 or 2 (Factory set to 1)
Data Interface Levels - Transmit or receive using EIA voltage levels (+8V and -8V)

Note: For the not supported settings, the interface will respond, but the card has not been tested with these settings at the factory. X is a don't care setting for that switch.

WARNING
To prevent shock hazard, turn off the instrument, disconnect it from AC line power and all test equipment before removing cover.

2. Set the POWER switch to OFF and disconnect the power cord from the unit. Remove the two top panel screws and slide the panel off. Note on the calibration cover the position of the Interface Option where the 8053 will be.

3. Remove the three screws that secure the calibration cover to its clips and remove the cover. Remove the two back panel mounting screws that secure the J2 blank cover plate to the interface opening and remove the plate.

4. Remove the red jumper JMP6 on the Microprocessor Board. This is the jumper closest to the front edge of the microprocessor card.

5. Turn on DIP Switch 3 of switch package S4 on the 805 main board.

6. Plug the internal interface cable attached to the 8053 into option connector JC on the 805 main board with the locking tab configured properly.

7. Position the 8053 interface 25 pin RS-232C connector in the J2 opening on the 805 back panel and secure it in place with the screws removed earlier (note: the transformer wires that run along the rear edge of the transformer may have to be adjusted to install the 8053).

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8. Install the calibration cover by reversing procedure 3.

9. Install the top panel.

8053.6 OPERATION

The 8053 RS-232C Interface has a 256 character FIFO buffer for input commands. The interface accepts commands, the same as for the IEEE-488 Interface, until it sees the End-of-Line (EOL) sequence. The 8053 requires a carriage return/line feed (CR)(LF) or just line feed (LF) as its input EOL and transmits carriage return/line feed (CR)(LF) as its output EOL. Following the EOL Sequence the command string is processed.

Operation of the Interface link is initiated by the computer. The computer will transmit either a Program Code or an Output Request to the 8053 Interface. The 805 will respond to the Output Request with the appropriate response or with the response and an error message (if an error was detected). The interface responds to Program Code Commands by storing the variables input.

The Programming Codes given in Tables 4-4 and 4-5 are input only and do not result in a response from the interface. The Codes TN_1 and ZN_1 will be accepted and updated even though they have no relevance to the interface (the EOL terminator sequence is always (CF)(LF) and there is no EOI status). The MN_1 command can be considered the "OFF LINE" (Local) and "ON LINE" (Remote or Remote with Local Lockout) states. When "OFF LINE" (Local) parameters such as SENSOR ID (as well as Gain and Reset) are updated from the hardware settings while "ON LINE" these parameters can be updated from the computer only.

The Output Statement commands given in Tables 4-7 and 4-8 will result in the requested data being output immediately following the reception of the EOL sequence. If more than one Output Statement command is given, the last one received will be acknowledged. Programming Codes and Output Statements can be sent in the same command string. For example, the command string:

S24.5P40I20R3

would result in the Set Point being updated to 24.5, the Gain to 40, the Reset to 20 and the Heater Range to LO. No Output Statement was given so no response will be output by the interface. The command string:

S24.5P40I20R3W0

will result in the W0 contents being output by the interface. (Refer to Section 4 for a detailed discussion of the Output Statement commands.)

There are three errors that could be detected by the 8053 interface as defined in Table 8053-5. Detection of an error does not effect the operation of the interface. The software that interprets the data tries to match the character input to the possible command inputs and processes the command. The error is also transmitted by the interface the next time it is asked for a response. The error is transmitted in addition to the Output Statement data output. For example, if a framing error were detected in a command string:

P50W3

the interface might respond with:

Err12
50.,20.,3,047(CR)(LF)

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If the error were detected in the transmission of the "P", the gain change would be ignored; if it was in the "50", one or two numerics may have been generated. If the error were detected in the "W", the interface may not respond, in which case it would need to see another Output Statement command. If the error was in the "1", the interface may or may not have responded with W1 data, it may default to W0. Although errors rarely occur, it is suggested that any commands sent to the 805 be echoed back by sending the appropriate Output Statement command and inputting the stored parameters. Any error that is detected is cleared following the first transmission after the error.

Table 8053-5. Interface Error Codes

Number	Error/Possible Cause
Err10	Parity Error - may be caused by signal line transients or incorrectly specified parity.
Err11	Overrun Error - caused by the main processor not reading the input character before the next one becomes available. The overrun character(s) are lost.
Err12	Framing Error - may be caused by signal line transients or incorrectly specified stop bits or or character length.
Err13	Input Buffer Overrun - caused by more than 256 characters being input input to the FIFO buffer. Any characters received after the 256th character are lost.

8053.7 INTERFACING EXAMPLES

Example 1. HP-86B Computer, Half Duplex Without Handshake.

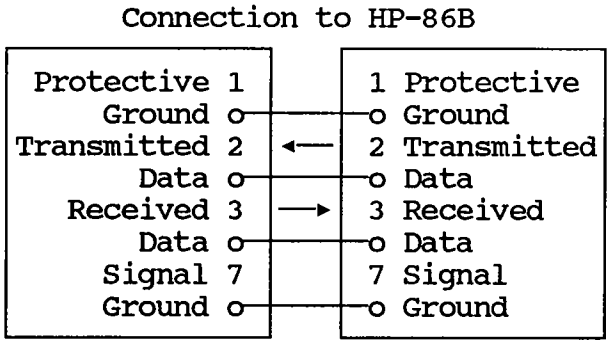
The HP82939A Serial Interface for the HP-86B is preset at the factory for the following default values:

1. Interface select code = 10
2. Baud rate = 300 Baud
3. Autohandshake = Off
4. Character Length = 7 bits
5. Parity = Odd
6. Stop bits = 1
7. Cable Option = Standard (25 pin socket)

Since the HP default Baud rate, character length, parity and stop bit configuration are the same as those of the 8053 Interface when shipped, none of the switches on the 8053 board need to be changed.

When connecting the HP-86B Serial Interface to the 8053 Interface, a transition cable needs to be made to connect the socket connector of the HP to the socket connector of the 8053 Interface. Figure 8053-2 shows the adapter cable that must be made. The arrows indicate the source and direction of signal flow.

Figure 8053-2. Half Duplex W/O Handshake



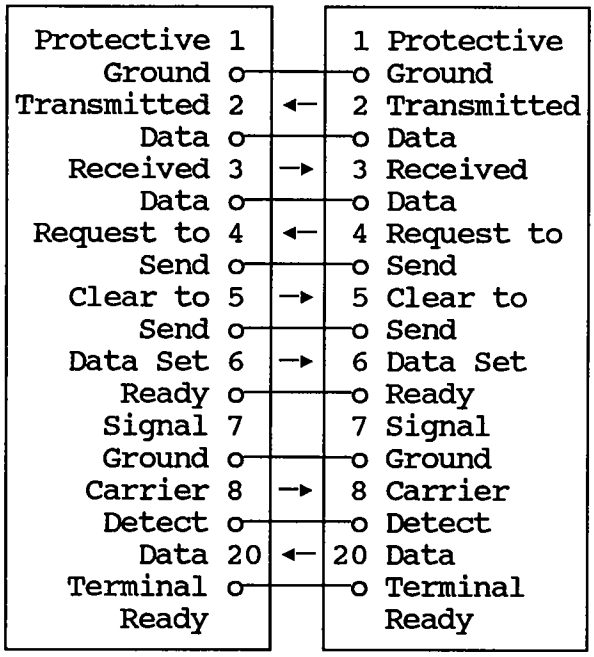
The following program will input a command from the keyboard and output it to the 8053. The program will then input the specified 8053's response, display it and return for another command.

```
10 REM HALF DUPLEX W/O HANDSHAKE
15 REM I/O TEST (RS232 TEST1)
20 DIM A$[256],B$[3000]
25 REM A$ IS OUTPUT, B$ IS INPUT
30 INPUT A$ ! MAKE SURE TO GIVE AN
35     ! OUTPUT STATEMENT COMMAND
40 OUTPUT 10 ; A$ ! OUTPUT COMMAND
50 ENTER 10 ; B$  ! INPUT THE DATA
55           ! FROM THE CONTROLLER
60 DISP B$   ! DISPLAY DATA
70 GOTO 30   ! RETURN FOR MORE
80 END
```

Example 2. HP-86B Computer, Half Duplex, with Handshake.

Figure 8053-4 shows the adapter cable for Half Duplex with handshake communications with an HP-86B Serial Interface. The arrows indicate the source and direction of signal flow.

Figure 8053-4. Half Duplex, with Handshake



The Auto Handshake capability of the HP-86B Serial Interface must be enabled. The addition of the program line:

```
16 CONTROL    10,2;7  ! ENABLE
DSR,DCD,CTS
```

to the program above enables the HP to receive and transmit in a handshake mode.

Example 3. General Serial Interface Interconnection.

The HP-86B Serial Interface Standard cable configuration already takes care of some of the interface interconnection problems to route signals to their proper pins. Figures 8053-5 and 8053-6 give more general interconnection configurations for Half Duplex with and without Handshake.

Figure 8053-5. General Serial Interface Interconnection for Half Duplex with Handshake

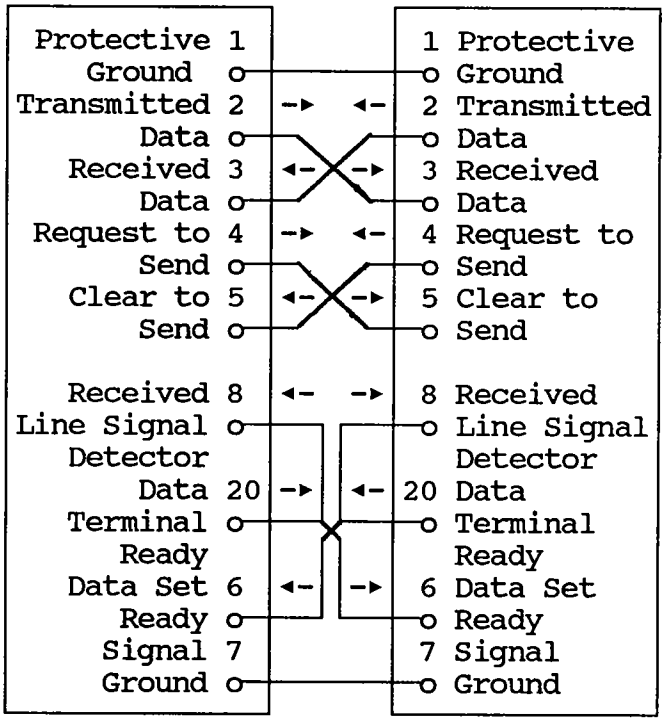


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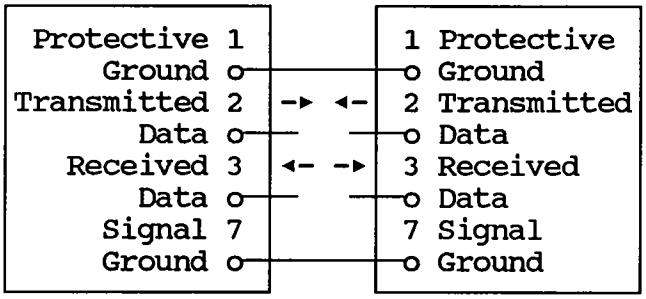
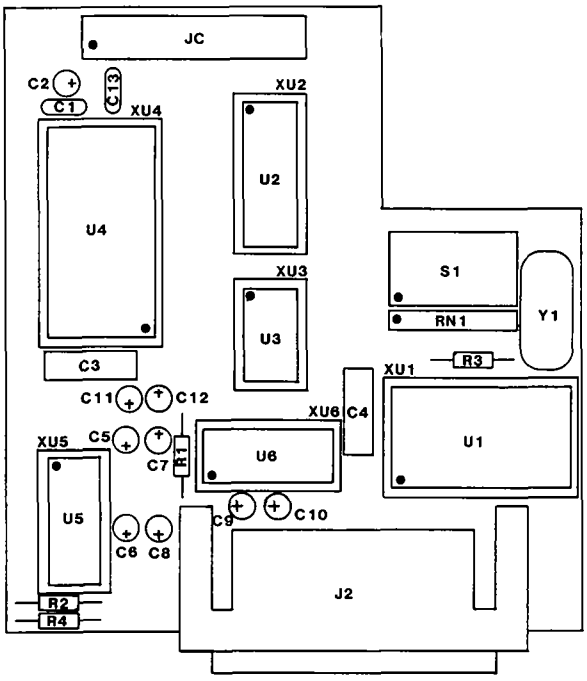
Figure 8053-6. General Serial Interface Interconnection for Half Duplex without Handshake



*Note: It may be necessary to jumper pins 5, 6, 8 and 20 to disable the handshake functions of the Host. This is not required for the 8053 Interface.

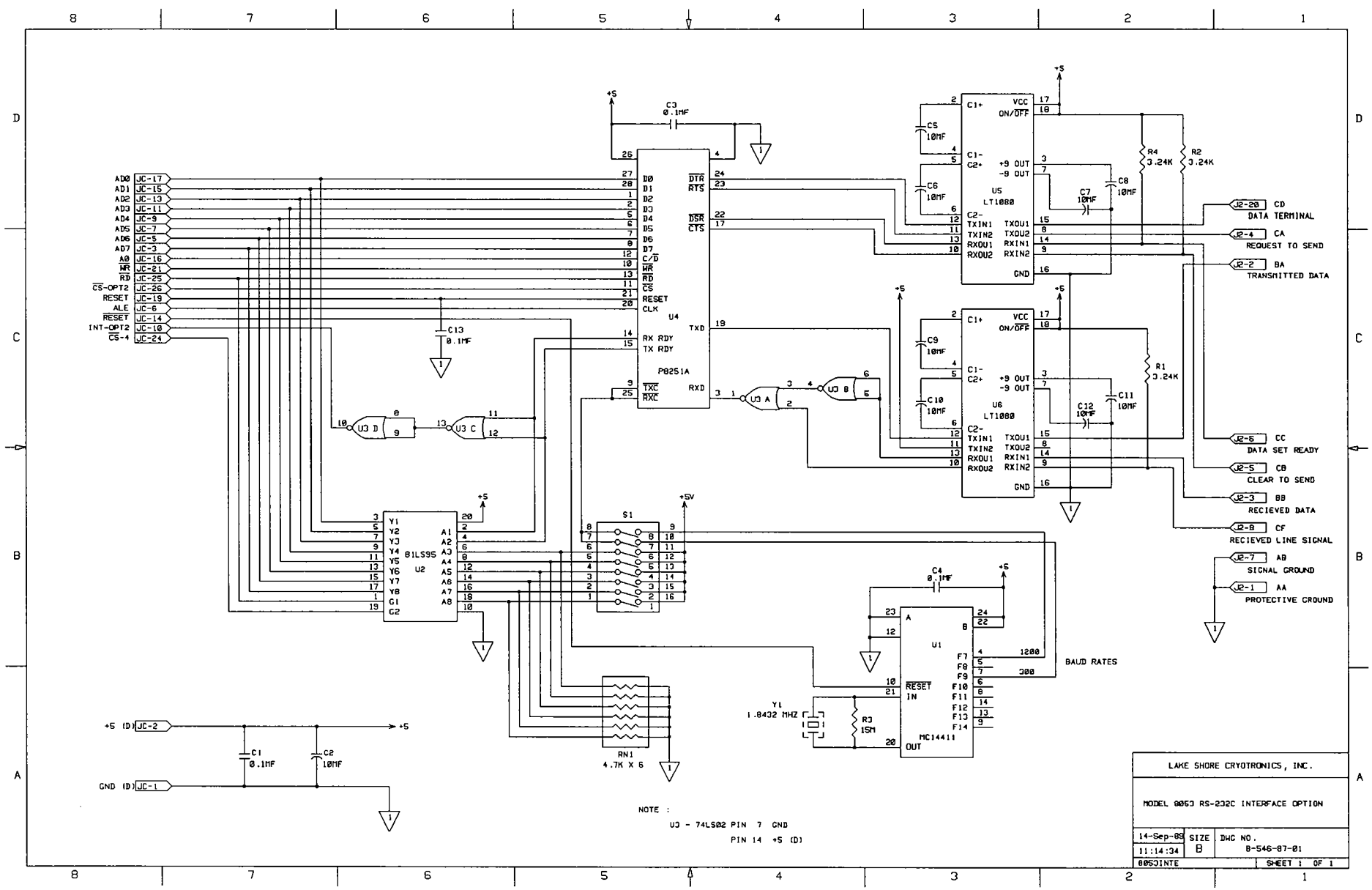
8053.8 REPLACEABLE PARTS

See Figure 8053-1.



REPLACEABLE PARTS LIST - 8053 RS-232C INTERFACE OPTION

ITEM NO	LSCI Part Number	Qty	Description	MFR	MFR PART NO
JC		1	CABLE (8053 TO MB)	LSCI	
J2	106-249	1	25 PIN RA D-STYLE CONNECTOR (RS-232C)	TRW	DBL-25S-2
S1	105-408	1	DIP SWITCH 8 POS	GYH	76SB08
U1	104-053	1	IC, BAUD GENERATOR	MOT	MC14411
U2	104-310	1	IC, 8 BIT MULTIPLEXER	NAT	DM81LS95AN
U3	104-203	1	IC, QUAD 2 INPUT NOR		74LS02
U4	104-523	1	IC UART	INT	P8251A
U5,6	104-722	1	IC, LINE DRIVER	LT	LT1080
Y1	103-991	1	CRYSTAL, 1.8432 MHZ	MTRON	MP-2-1.8432 MHZ


AD0 JC-17
AD1 JC-15
AD2 JC-13
AD3 JC-11
AD4 JC-9
AD5 JC-7
AD6 JC-5
AD7 JC-3
A0 JC-16
MR JC-21
RD JC-25
CS-OPT2 JC-26
RESET JC-19
ALE JC-6
RESET JC-14
INT-OPT2 JC-10
CS-4 JC-24
P8251A
U4
81LS95
U2
U1
MC14411
LT1080
U5
U6
U3 A
U3 B
U3 C
U3 D
S1
RN1
4.7K X 6
Y1
1.8432 MHZ
R3
15M
C1
0.1MF
C2
10MF
C3
0.1MF
C4
0.1MF
C5
10MF
C6
10MF
C7
10MF
C8
10MF
C9
10MF
C10
10MF
C11
10MF
C12
10MF
C13
0.1MF
R1
3.24K
R2
3.24K
R4
3.24K
+5 (D) JC-2
GND (D) JC-1
J2-20 CD
DATA TERMINAL
J2-4 CA
REQUEST TO SEND
J2-2 BA
TRANSMITTED DATA
J2-6 CC
DATA SET READY
J2-5 CB
CLEAR TO SEND
J2-3 BB
RECIEVED DATA
J2-8 CF
RECIEVED LINE SIGNAL
J2-7 AB
SIGNAL GROUND
J2-1 AA
PROTECTIVE GROUND
1200
300
BAUD RATES
NOTE :
U3 - 74LS02 PIN 7 GND
PIN 14 +5 (D)
LAKE SHORE CRYOTRONICS, INC.
MODEL 8053 RS-232C INTERFACE OPTION
14-Sep-89
11:14:34
SIZE
B
DWG NO.
8-546-87-01
8053INTE
SHEET 1 OF 1

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MODEL 8054 IEEE-488 INTERFACE

8054.1 INTRODUCTION

This Section contains installation and maintenance information pertaining to the Model 8054 IEEE-488 Interface for the Model 805 Temperature Controller. A description as well as operation and programming information is given in Section 4 of the manual.

8054.2 INSTALLATION

The 8054 IEEE-488 Interface is factory installed if ordered with a Model 805 Temperature Controller or can be field installed at a later date. If field installation is required, use the following procedure.

WARNING
To prevent shock hazard, turn off the instrument, disconnect it from AC line power and all test equipment before removing cover.

1. Set the POWER switch to OFF and disconnect the power cord from the unit. Remove the two top panel screws and slide the panel off. Note on the calibration cover the position of the Interface Option where the 8054 will be.

2. Remove the three screws that secure the calibration cover to its clips and remove the cover. Remove the two back panel mounting screws that secure the J2 blank cover plate to the interface opening and remove the plate.

3. Turn off DIP Switch 3 of switch package S4 on the 805 main board.

4. Plug the internal interface cable attached to the 8054 into option connector JC on the 805 main board with the locking tab configured properly.

5. Position the 8054 interface 24 pin IEEE-488 connector in the J2 opening on the 805 back panel and secure it in place with the screws removed earlier (note: the transformer wires that run along the rear edge of the transformer may have to be adjusted to install the 8054).

6. Install the calibration cover by reversing procedure 2.

7. Install the top panel.

8. Configure the address switches as shown in Section 4.4.

8054.3 REPLACEABLE PARTS

Included in this Section are the Model 8054 schematic, replaceable parts list and illustrated component layout. Refer to the manual for ordering information.

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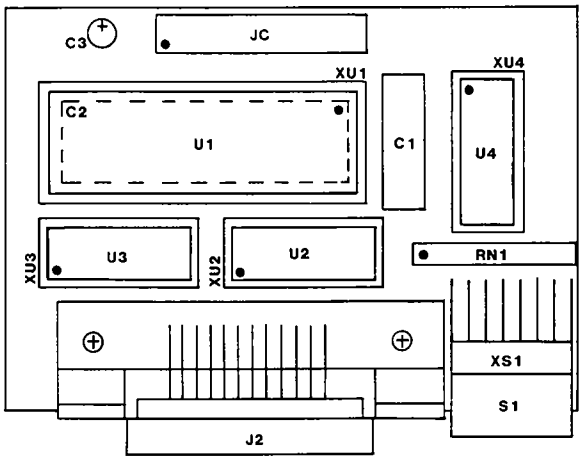
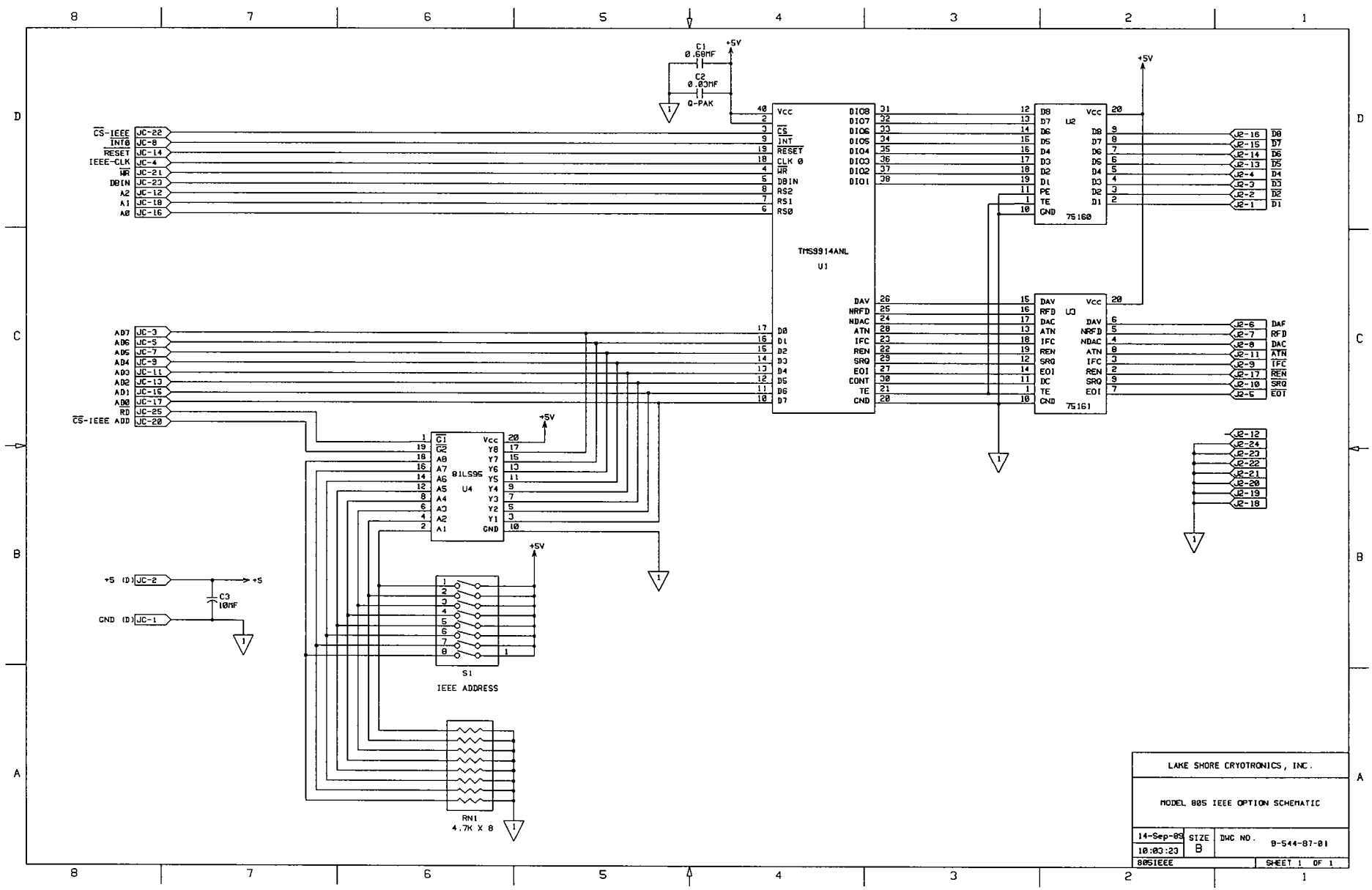


REPLACEABLE PARTS LIST - 8054 IEEE-488 INTERFACE OPTION

ITEM NO	LSCI Part Number	Qty	Description	MFR	MFR PART NO
JC	106-428	1	CABLE (8054 TO MB)	LSCI	
J2	106-310	1	24 PIN RA D-STYLE CONNECTOR (IEEE)	AML	57-92245-12
S1	105-408	1	DIP SWITCH 8 POS	GYH	76SB08S
U1	104-712	1	IC, IEEE CHIP	TI	TMS9914ANL
U2	104-710	1	IC, IEEE SUPPORT CHIP	TI	SN75160AN
U3	104-711	1	IC, IEEE SUPPORT CHIP	TI	SN75161AN
U4	104-310	1	IC, 8 BIT MULTIPLEXER	NAT	DM81LS95AN


C1
0.68MF
C2
0.03MF
Q-PAK
+5V
TMS9914ANL
U1
75160
U2
75161
U3
81LS95
U4
S1
IEEE ADDRESS
RN1
4.7K X 8
C3
10MF
LAKE SHORE CRYOTRONICS, INC.
MODEL 805 IEEE OPTION SCHEMATIC
14-Sep-89
10:03:23
SIZE
B
DWG NO.
8-544-87-01
805IEEE
SHEET 1 OF 1

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MODEL 8055 ANALOG OUTPUT

8055.1 INTRODUCTION

This section contains information pertaining to the Model 8055 Analog Output for the Model 805 Temperature Controller. Included is a description, specifications, installation, operation and maintenance information.

8055.2 DESCRIPTION

The 8055 Analog Output is designed to be installed in a Model 805 and provide an analog output proportional to the Kelvin temperature of the display sensor for the purpose of recording, either with a strip chart recorder or other similar device, the sensor temperature.

The analog output is present on the J1 SENSORS/MONITORS connector on the 805 back panel with pin 18 being the V+ output and pin 19 being the V- output.

8055.3 SPECIFICATIONS

Specifications for the Model 8055 Analog Output are given in Table 8055-1.

8055.4 INSTALLATION

The 8055 can be installed in the Model 805 Option Slot 1. The 8055 Analog Output is factory installed if ordered with a Model 805 or can be field installed at a later date. If field installation is required use the following procedure.

WARNING
To prevent shock hazard, turn off the instrument and disconnect it from AC line power and all test equipment before removing cover.

Table 8055-1. Model 8055 Analog Output Specifications

Output Range - 0.000 to +10.000 V
Output Resolution - 1mV out of 10V
Output Resistance - Less than 10Ω
Output Equivalence
Temperature for all Input Modules - Output: 0.000 to 9.999 V for display of 0 to 999.9 K - Sensitivity: 10 mV/K
Voltage - Output: 0.0000 to 6.554 V for display 0.0000-6.5535 V - Sensitivity: 1 V/V.
Resistance (805-P2, -P3 and -R1) -P2: - Output - 0.000 to 3.000 V for display 0.00 - 300.00 Ω - Sensitivity - 10 mV/ohm -P3: - Output - 0.000 to 3.000 V for display 0.0 - 3000.0 Ω - Sensitivity - 1 mV/ohm -R1 - Output - 0.000 to 10.000 V for display 0.000 - 99.999 Ω - Sensitivity - 100 mV/ohm

1. Set the power switch to OFF and disconnect the power cord from the unit. Remove the two top panel screws and slide the panel off. Note on the calibration cover the position of Option Slot 1 which the 8055 will occupy.

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2. Remove the three screws that secure the calibration cover to its clips and remove the cover.

3. Plug the 8055 printed circuit board into Option Slot 1 with the component side to the left of the unit as viewed from the front.

4. Install the calibration cover by reversing procedure in 3.

5. Install the top panel.

8055.5 OPERATION

The output resolution and equivalence is given in Table 8055-1. For a temperature display of 100.0 K the 8055 would output 1.000 V. The output is rounded to the equivalent unit for the 1 mV output. A display of 23.42 K would result in an output of 0.234 V and a display of 23.47 K would result in an output of 0.235 V.

8055.6 CALIBRATION

The Model 8055 has been calibrated to specification prior to shipment. If re-calibration is needed, use to the following procedure. The following equipment is used to calibrate the 8055 Analog Output:

1. Digital Voltmeter/Multimeter (DVM) - 4½ digit resolution or better.

2. Precision Standard Resistor to simulate the input sensor or a Precision Voltage Source with an output resolution of 100 uV out of 3 V or better.

The unit should be allowed one hour to warm up to achieve rated specifications. Use the following procedure to calibrate the 8055 Analog Output:

1. Remove the two top panel screws and slide the panel off.

2. Connect the DVM plus lead to the J1 SENSORS/MONITORS connector pin 18 and the minus lead to pin 19.

3. With the load resistors, or the voltage standard, to simulate the input sensor go to a low temperature and adjust the trimpot labeled Z (for Zero) on the calibration cover until the voltmeter reading corresponds to 10 mV/K. Go to a high temperature and adjust the trimpot labeled S (for Span).

4. Repeat procedure in 3 until there is no further Zero or Span adjustment required.

5. Install the top panel.

8055-7 REPLACEABLE PARTS

Included in this Section are the Model 8055 Analog Output schematic, replaceable parts list and illustrated component layout. Refer to the manual for ordering information.

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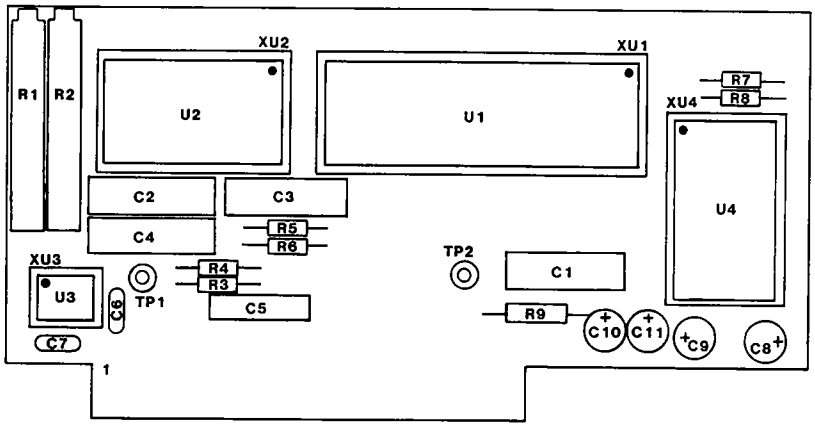
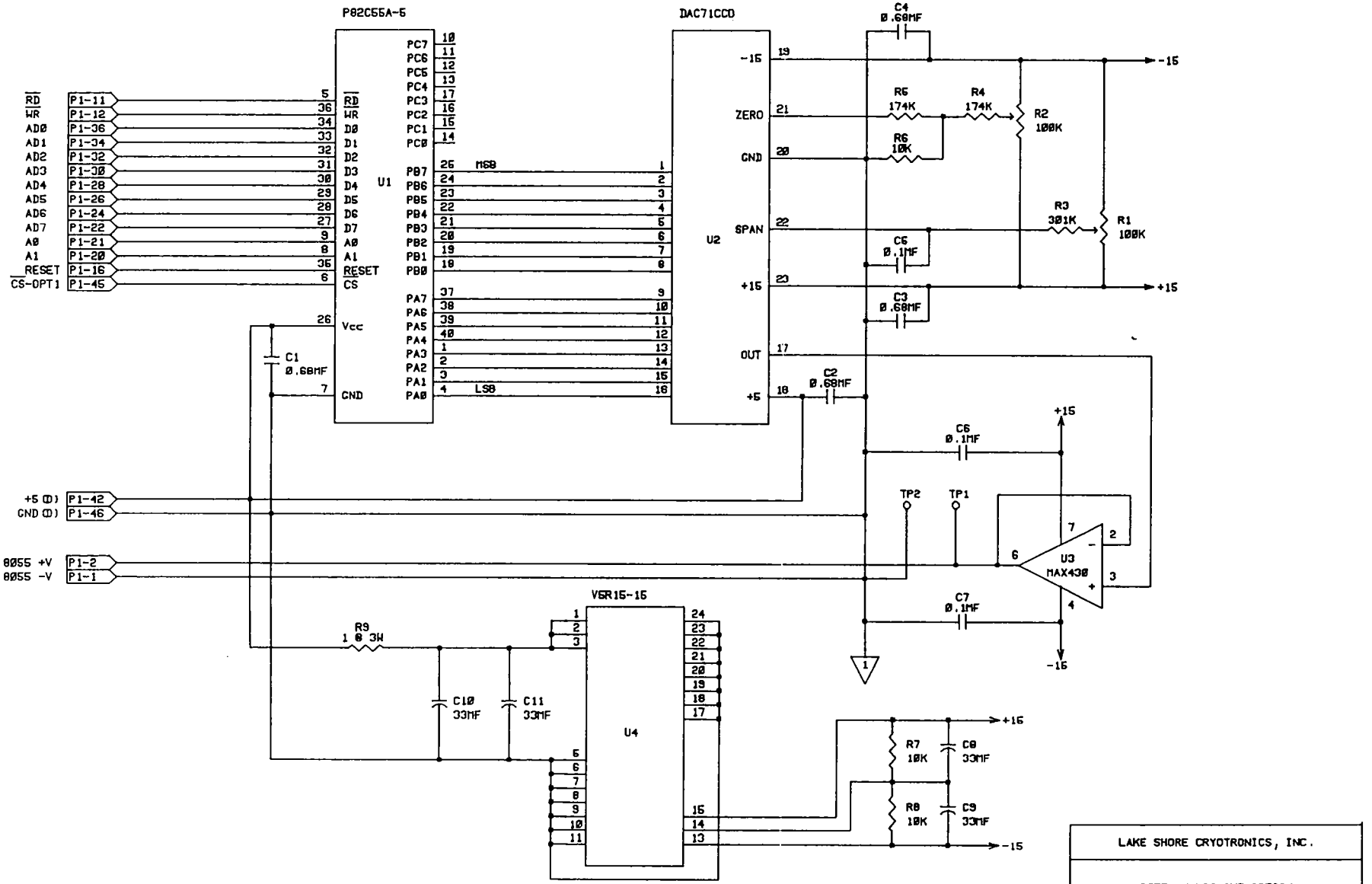


REPLACEABLE PARTS LIST - 8055 ANALOG OUTPUT OPTION

ITEM NO	LSCI Part Number	Qty	Description	MFR	MFR PART NO
U1	104-529	1	IC, PORT EXPANDER	INT	P82C55A-5
U2	104-425	1	IC, D/A CONVERTER	BB	DAC71-CCD-V
U3	104-089	1	IC, OP AMP	MAX	MAX430CCP
U4	104-482	1	DC-DC CONVERTER	REL	V5R15-15



LAKE SHORE CRYOTRONICS, INC.		
8055 ANALOG OUT OPTION		
10-01-87	SIZE B	DWG NO. 8-547-87-01
14:51:33		
8055AOUT		SHEET 1 OF 1

APPENDIX A - Standard Diode Voltage-Temperature Characteristics

TEMP(K)	D CURVE BP#	D CURVE VOLTAGE	E1 CURVE BP#	E1 CURVE VOLTAGE	DT-470 CURVE 10 BP#	DT-470 CURVE 10 VOLTAGE
1.4		2.5984	30	2.6591	29	1.69808
1.5		2.5958		2.6567		1.69674
1.6		2.5932		2.6542		1.69521
1.7		2.5906		2.6518		1.69355
1.8		2.5880		2.6494		1.69177
1.9		2.5854		2.6470		1.68987
2.0	30	2.5828	29	2.6446	28	1.68912
2.2		2.5735		2.6355		1.68352
2.4		2.5643		2.6265		1.67880
2.6		2.5551		2.6175		1.67376
2.8		2.5458		2.6084		1.66845
3.0	29	2.5366	28	2.5994		1.66292
3.2		2.5226		2.5868		1.65721
3.4		2.5086		2.5742		1.65134
3.6		2.4946		2.5616		1.64529
3.8		2.4807		2.5490	27	1.64112
4.0		2.4667	27	2.5364		1.63263
4.2		2.4527		2.5221		1.62602
4.4		2.4387		2.5077		1.61920
4.6		2.4247		2.4934		1.61220
4.8		2.4108		2.4791		1.60506
5.0		2.3968		2.4648		1.59782
5.5		2.3618		2.4290		
6.0		2.3269		2.3932		1.56027
6.5		2.2919		2.3574		1.54097
7.0		2.2570		2.3216		1.52166
7.5		2.2220		2.2858		1.50272
8.0		2.1871		2.2500		1.48443
8.5		2.1521		2.2142		1.46700
9.0	28	2.1172	26	2.1784	26	1.44850
9.5		2.0909		2.1516		1.43488
10.0		2.0646		2.1247		1.42013
11.0		2.0119		2.0708		1.39287
12.0		1.9592		2.0170	25	1.36687
13.0	27	1.9066	25	1.9632		1.34530
14.0		1.8338		1.9011		1.32412
15.0	26	1.7610		1.8390		1.30422
16.0		1.6984		1.7769		1.28527
17.0	25	1.6359		1.7148		1.26702
18.0		1.5646	24	1.6527		1.24928
19.0		1.4932		1.5724		1.23184
20.0		1.4219		1.4922	23	1.21555
21.0	24	1.3505		1.4120		1.19645
22.0		1.3006	23	1.3317		1.17705
23.0	23	1.2507		1.2837		1.15558
24.0		1.2114	22	1.2357	22	1.13598
25.0	22	1.1720	21	1.1877	21	1.12463

26.0	21	1.1486	20	1.1559	20	1.11896
27.0	20	1.1308	19	1.1365	19	1.11517
28.0	19	1.1190	18	1.1239	18	1.11202
29.0	18	1.1116	17	1.1150		1.10945
30.0	17	1.1058	16	1.1080		1.10702
31.0					17	1.10465
32.0	16	1.0970	15	1.0981		1.10263
34.0	15	1.0902	14	1.0909		1.09864
36.0		1.0850	13	1.0848	16	1.09477
38.0		1.0798		1.0797		1.09131
40.0	14	1.0746	12	1.0746		1.08781
44.0					15	1.08105
45.0		1.0633		1.0630		
50.0		1.0520		1.0515		1.07053
55.0	13	1.0407		1.0399		
60.0		1.0287	11	1.0284	14	1.05277
65.0		1.0166		1.0159		1.04353
70.0	12	1.0046		1.0035		1.03425
75.0		.99172	10	0.9911		1.02482
77.35				0.9849		
77.4					13	1.02044
80.0		.97890		0.9780		1.01525
85.0		.96609		0.9649		1.00552
90.0	11	.95327		0.9518		.99565
95.0		.93987		0.9388	12	.98574
100.0		.92647	9	0.9257		.97550
105.0		.91307		0.9122		.96524
110.0		.89966		0.8988		.95487
115.0		.88626		0.8853	11	.94455
120.0		.87286		0.8718		.93383
125.0		.85946		0.8584		.92317
130.0	10	.84606	8	0.8449		.91243
135.0		.83228		0.8311		.90161
140.0		.81850		0.8173	10	.89082
145.0		.80472		0.8035		.87976
150.0		.79094		0.7896		.86873
155.0		.77716		0.7758		.85764
160.0		.76338		0.7620		.84650
165.0		.74961		0.7482	9	.83541
170.0	9	.73582	7	0.7344		.82404
175.0		.72170		0.7202		.81274
180.0		.70757		0.7060		.80138
185.0		.69344		0.6918		.78999
190.0		.67931		0.6777		.77855
195.0		.66518		0.6635	8	.76717
200.0		.65105		0.6493		.75554
205.0		.63693		0.6351		.74398
210.0		.62280		0.6210		.73238
215.0		.60867		0.6068		.72075
220.0	8	.59455	6	0.5926		.70908
225.0		.58080		0.5789		.69737
230.0		.56707		0.5651	7	.68580

235.0		.55334		0.5514		.67387
240.0	7	.53960	5	0.5377		.66208
245.0		.52649		0.5246		.65026
250.0		.51337		0.5115		.63841
255.0		.50026		0.4984		.62654
260.0		.48714		0.4853		.61465
265.0	6	.47403	4	0.4722		.60273
270.0		.46057		0.4588		.59080
275.0		.44711		0.4454		.57886
280.0		.43365		0.4320	6	.56707
285.0	5	.42019	3	0.4186		.55492
290.0		.40613		0.4045		.54294
295.0		.39208		0.3904		.53093
300.0		.37802		0.3763		.51892
305.0	4	.36397	2	0.3622		.50689
310.0		.34940		0.3476		.49484
315.0		.33482		0.3330		.48278
320.0		.32025		0.3184		.47069
325.0		.30568		0.3038		.45858
330.0		.29111	1	0.2893		.44647
335.0		.27654				.43435
340.0		.26197			5	.42238
345.0	3	.24739				.41003
350.0		.23325				.39783
355.0		.21911				.38561
360.0		.20497				.37337
365.0	2	.19083				.36110
370.0		.17774				.34881
375.0		.16464				.33650
380.0	1	.15155				.32416
385.0					4	.31180
390.0						.29958
395.0						.28700
400.0						.27456
405.0						.26211
410.0						.24963
415.0						.23714
420.0						.22463
425.0						.21212
430.0						.19961
435.0					3	.18696
440.0						.17464
445.0						.16221
450.0						.14985
455.0						.13759
460.0					2	.12536
465.0						.11356
470.0						.10191
475.0					1	.09032

APPENDIX A - DIN Standard Curve for 100 ohm Platinum Sensors

28	30.0	3.82000
27	32.0	4.23481
	34.0	4.68000
26	36.0	5.14601
	38.0	5.65000
25	40.0	6.17000
24	42.0	6.72621
	44.0	7.31000
23	46.0	7.90899
	48.0	8.57000
	50.0	9.24000
22	52.0	9.92364
	54.0	10.66000
	56.0	11.41000
21	58.0	12.17995
	60.0	12.99000
20	65.0	15.01541
	70.0	17.11000
19	75.0	19.22302
	80.0	21.36000
18	85.0	23.52499
	90.0	25.67000
	95.0	27.82000
	100.0	29.95000
17	105.0	32.08087
	110.0	34.16000
	115.0	36.25000
	120.0	38.34000
	125.0	40.42000
	130.0	42.49000
	135.0	44.57000
16	140.0	46.64758
	145.0	48.69000
	150.0	50.75000
	155.0	52.80000
	160.0	54.84000
	165.0	56.88000
	170.0	58.92000
15	175.0	60.96840
	180.0	62.98000
	185.0	65.00000
	190.0	67.01000
	195.0	69.02000
	200.0	71.03000
	205.0	73.03000
14	210.0	75.04385
	215.0	77.02000
	220.0	79.00000
	225.0	80.98000
	230.0	82.96000
	235.0	84.94000
	240.0	86.92000
	245.0	88.90000
	250.0	90.88000
	255.0	92.86000

	260.0	94.83000
	265.0	96.80000
13	270.0	98.78433
	275.0	100.72000
	280.0	102.67000
	285.0	104.62000
	290.0	106.57000
	295.0	108.51000
	300.0	110.45000
	305.0	112.39000
	310.0	114.32000
12	315.0	116.27003
	320.0	118.19000
	325.0	120.11000
	330.0	122.03000
	335.0	123.95000
	340.0	125.86000
	345.0	127.78000
	350.0	129.69000
11	355.0	131.61563
	360.0	133.50000
	365.0	155.40000
	370.0	137.31000
	375.0	139.20000
	380.0	141.09000
	385.0	142.98000
	390.0	144.87000
	395.0	146.76000
10	400.0	148.65215
	405.0	150.51000
	410.0	152.39000
	415.0	154.26000
	420.0	156.14000
	425.0	158.01000
	430.0	159.87000
	435.0	161.73000
	440.0	163.59000
9	445.0	165.46573
	450.0	167.30000
	455.0	169.15000
	460.0	171.00000
	465.0	172.84000
	470.0	174.68000
	475.0	176.52000
	480.0	178.36000
	485.0	180.19000
8	490.0	182.03545
	495.0	183.85000
	500.0	185.67000
	505.0	187.49000
	510.0	189.32000
	515.0	191.13000
	520.0	192.94000
	525.0	194.75000
	530.0	196.56000

7	535.0	198.38649
	540.0	200.17000
	545.0	201.96000
	550.0	203.75000
	555.0	205.54000
	560.0	207.33000
	565.0	209.12000
	570.0	210.91000
	575.0	212.69000
	580.0	214.46000
6	585.0	216.25553
	590.0	218.01000
	595.0	219.78000
	600.0	221.55000
	605.0	223.31000
	610.0	225.07000
	615.0	226.83000
	620.0	228.59000
	625.0	230.34000
5	630.0	232.10593
	635.0	233.84000
	640.0	235.57000
	645.0	237.31000
	650.0	239.06000
	655.0	240.79000
	660.0	242.52000
	665.0	244.25000
	670.0	245.97000
4	675.0	247.71350
	680.0	249.42000
	685.0	251.14000
	690.0	252.85000
	695.0	254.56000
	700.0	256.27000
	705.0	257.97000
	710.0	259.68000
3	715.0	261.39092
	720.0	263.07000
	725.0	264.77000
	730.0	266.46000
	735.0	268.14000
	740.0	269.83000
	745.0	271.51000
	750.0	273.19000
	755.0	274.87000
2	760.0	276.56633
	765.0	278.22000
	770.0	279.88000
	775.0	281.55000
	780.0	283.21000
	785.0	284.87000
	790.0	286.53000
	795.0	288.18000
1	800.0	289.83000

A P P E N D I X B

Sensor Curve 18 Character Information Line
Reserved Character Definitions

Each Sensor Curve has an 18 character information line. Some of the characters are reserved for specific operations. The definitions are as follows:

Character	Description
1	Curve type: (L) - Unit performs Lagrangian calculations on the data. Any other character - Unit performs Straight - Line interpolation on the data.
2	Temperature Range (Setpoint Limit): (0) - Up to 324.9 K. (1) - Up to 374.9 K. (2) - Up to 474.9 K. (3) - Up to 799.9 K. (4) - Up to 999.9 K.
3	Sensor type (used for front panel curve entry here alphanumerics cannot be entered with the standard numeric keypad): (0) - DT-470 Series Silicon Diode Sensors (1) - DT-500 Silicon Diode Sensors (2) - TG-100/TG-200GaAs and GaA/As (3) - 100 Ohm Platinum Resistance Thermometers (PRT's) (4) - 1000 Ohm Platinum Resistance Thermometers (PRT's) (5) - Rhodium-Iron Resistance Sensors (6) - Germanium Resistance Sensors (7) - Carbon-Glass Resistance Sensors (8) - Capacitance Sensors (9) - Reserved (for Thermocouples)

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Character	Description
13 thru 18	Stored in the Sensor Curve Information Table (typically where the sensor serial number is stored in Precision Options). The sensor serial number formats are as follows (where # is used to indicate a 0-9 numeric): Sensor Type — Format 0 — D##### 1 — D##### 2 — #### 3 — P#### 4 — P#### 5 — #### 6 — ##### 7 — C#### 8 — #### 9 — No S/N

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A P P E N D I X C

805 Error Code Summary

The error codes for the 805 are separated into categories. The Err0x codes are for mainframe error conditions, the Err1x codes are for Input Card error conditions. If an Err0x, or an OL or Err2x error occurs for an input selected as the control input, the heater range is taken to OFF and must be reset following correction of the fault condition. The following is a summary of the error codes.

Error Code	Possible Cause/Corrective Action
Err01	The unit encountered an unwriteable NOVRAM data location. When this error occurs, the unit displays the error, stores it in the WS data location and halts operation. The NOVRAM initialization sequence should be performed to try to correct the problem. If the error code still exists, the NOVRAM needs to be replaced.
Err02	The unit performs a NOVRAM check on power-up. If the unit detects a NOVRAM data error (or if the interface XR&I* function was performed) the unit displays the error, stores it in the WS data location and waits for the NOVRAM initialization sequence to be performed.Repeated Err02 conditions could signal a failure by the NOVRAM to retain data and it should be replaced.
Err09	The REMOTE SENSOR ID for the unit allows for an input range of 00 (00000 on bits B4 thru B0 of the ID) to 1F (11111 on bits B4 thru B0). The 1F input is reversed for a REMOTE SENSOR ID error condition (the Position Data Adaptor uses this code to indicate that more than one Sensor Scanner is active to the unit). When the error, stores it in the WS data location and continues to monitor the REMOTE SENSOR ID until the fault is corrected.
Err10	8053 RS-232C Interface Parity Error. The error may be caused by problems with the signal lines or incorrectly specified parity. The error, and any of the other 805-RS errors, is transmitted when the unit is asked to output and is cleared following the first transmission after the error.

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Error Code	Possible Cause/Corrective Action
Err11	8053 RS-232C Interface Overrun Error. The error is caused by the unit's main processor not reading the input character before the next one becomes available. The overrun character(s) are lost.
Err12	8053 RS-232C Interface Framing Error. The error may be caused by signal line transients or incorrectly specified stop bits or character length.
Err13	8053 RS-232C Interface Input Buffer Overrun Error. The error occurs when more than 256 characters are input to the FIFO buffer of the unit. Any characters received after the 256th character are lost.
OL	Input Overload. When an input signal which exceeds the maximum allowed for that input is applied the error occurs. When the error occurs, the displays OL if it is the DISPLAY SENSOR input and stores OL in either the WS and/or WC data locations.

Continued on next page

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Error Code	Possible Cause/Corrective Action
Err25	Unrecognized A Input Card type. The 805 Series cards and "Smart" (microprocessor controlled)Input Cards tell the main processor what card type they transmitted,the error could be caused by the Input Card not being present or if the card had a selection switch de-selected (for example, if it were not pressed correctly or came out of detent in shipping). When the error occurs, the unit displays dashes (-----)if it is the DISPLAY SENSOR input and continues operation until the fault is corrected. The error is stored in the WI A Input data location and is displayed when the LOCAL key is pressed to determine the Input Card type.
Err26	Unrecognized B Input Card type. Operation is the same for Err25 except the error is stored in the WI B Input data location.
Err27	Incorrect A Input Card polarity. The 805 Series Input Cards determine the input signal polarity doesn't match the temperature coefficient of the sensor type selected, there is either an error in the sensor wiring an open circuit or a fault on the Input Card. When the error occurs, the unit displays the error if it is the DISPLAY SENSOR input and continues operation until the fault is corrected. The error is stored in the WI A Input data location and is displayed when the LOCAL key is pressed to determine the Input Card type.
Err28	Incorrect B Input Card polarity. Operation is the same as for Err27 except the error is stored in the WI B Input data location.

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Lake Shore Cryotronics, Inc.
64 E. Walnut St., Westerville, Ohio 43081
(614) 891-2243 • Telex: 24-5415 • Cryotron WTVL

Model 805
Temperature Controller

A Versatile Wide Range Temperature Controller

- Temperature Range 1.4 to 800K (−272° to 527°C)
- Two Sensor Inputs — Uses Diodes, Platinum and Rhodium-Iron RTDs, or a combination of these
- Digital Display in K, °C, °F, Ohms or Volts
- Real Time Analog Control
- Control Stability to Better than ± 0.01K
- IEEE−488 and RS−232C Interface Capability

The Model 805 Temperature Controller is an affordable, versatile instrument designed to manage a broad array of controlled temperature requirements in the science field — in low temperature physics (to as low as 1.4K), in low to moderate magnetic field environments, and in medium temperature applications to 800K (527°C).

Five sensor input types from which to choose. In its standard configuration the 805 controller is provided with two inputs that accommodate Lake Shore's interchangeable 3-Volt silicon diode sensors. Optional sensor inputs accommodate Lake Shore's gallium aluminum arsenide 6-Volt diodes, and 100/1000 ohm platinum or 27 ohm rhodium-iron RTDs. Different type sensors may be used in combination with one another. Either sensor input may be designated for control. Display of temperature can be independently switched between either input on the front panel.

Digital display function. Temperature readout may be selected in K, °C or °F, with display in up to four digits and resolution to 0.01 units. Diode voltage can be displayed to one millivolt, and RTD resistance to 0.1 ohm. Continous indication of setpoint temperature is provided via digital thumbwheel switches accessed from the front panel.

Three level heater output selection. From the HI mode setting, which provides up to 25 watts of D.C. current-controlled power to the heater, heater output can be attenuated in two further steps of a decade each to more closely parallel cooling capacity, thus optimizing temperature control performance. Optional output power of 60 watts is available. The 805 controller provides two-digit LED display of heater power output as a percentage of total available power.

The 8001 Precision Option provides the means for storing data for calibrated sensors within the 805 controller. The 8001 Precision Option consists of Lake Shore formatted sensor curve calibration data that is stored in the memory of the 805 controller. Lake Shore uses a proprietary algorithm to optimize the fit of the stored data with the sensor's actual calibration data points, producing an agreement that is typically ± 0.025K or better. Up to ten sensor curves may be stored in the controller through use of the 8001 option.

IEEE−488 and RS−232C Interface Capability. Use of either the IEEE−488 or RS−232C interface option permits remote control, with corresponding output data, of all front panel functions, including temperature control setpoint, desired temperature display units, gain, reset and heater power level selection.

Model 805 Temperature Controller Specifications

Inputs

Two Sensor Inputs (A and B): Control sensor (A or B) selected via rear panel switch. Display sensor (A or B) can be selected from front panel independent of control sensor selection. One sensor input conversion module required per input.

Sensor Input vs Temperature Range: See table below for corresponding listing of sensor type and applicable temperature range.

Sensor Response Curve: Standard curves provided with instrument: Lake Shore diode curves 10, DRC–"D" and DRC–"E1"; platinum RTD DIN 43760 (also see 8001 Precision Option).

Sensors (ordered separately): See table below.

Sensor Response Selection: Rear panel DIP switch permits selection of appropriate sensor response curve for each sensor input.

Displays

Display Resolution: kelvin/to 0.1K ≥ 100K, to 0.01K ≤ 100K; °C or °F/to 0.1 degrees; diodes to 1 mV; RTDs to 0.1 ohm.

Response Time (electronics): Less than one second to rated accuracy under continuous operation.

Heater Output Monitor: LED display continuously shows heater output as a percentage of total output power, with a resolution of 1%.

Temperature Control

Setpoint: Digital thumbwheel selection in kelvin, celsius, fahrenheit, ohms or volts (same units and resolution as display).

Control Stability: Better than ± 0.01K below 20K with a diode sensor in a properly designed system.

Control Modes: Proportional (gain) and integral (reset) set via front panel.

Heater Output: Real time analog output; variable D.C. current output; 25 watts (1A; 25V compliance; 25 ohm heater) standard. 60 watts available with W60 option. Three output ranges can be selected from front panel; from the HI mode setting, heater output can be attenuated in two further steps of a decade each.

General

Dimensions: 216mm wide × 102mm high × 381mm deep (8.5″ × 4″ × 15″) Style L, half-rack package.

Weight: Net weight 9 kg (20 lbs.)

Power: Selectable for 100, 120, 220, 240 volts, +5%; 50/60 Hz, 75 watts.

Accessories Supplied: Mating connector for sensor input/monitor connector, Operations Manual, detachable line cord.

Options Available

8001 Precision Option: Custom programmed read-only-memory (PROM) which improves specified accuracy to 0.1K or better over a given calibration range. Any DT–470 series silicon diode, TG–120 series gallium aluminum arsenide, PT–100 series platinum or RF–800 series rhodium-iron sensor can be utilized. Requires that an appropriate calibration be purchased for the sensor. Up to ten calibrations can be stored.

Input Conversion Modules:

805–6 6-Volt conversion for TG–120 series diodes

805–P2 100 ohm platinum conversion module

805–P3 1000 ohm platinum conversion module

805–R1 27 ohm Rh-Fe conversion module

8053. RS–232C Interface Option Card. Permits remote control, with corresponding output display, of all front panel functions.

8054. IEEE–488 Interface Option Card. May be used in lieu of RS–232C above. Permits same remote control capability.

8055. Analog output option card (0–1V).

W60. 60 watt output stage for 25 ohm heater; 1.5A, 40V.

HTR–50. 50 ohm cartridge heater, 50 watt, ¼″ (6.35mm) dia. × 1″ (25.4mm) long.

HTR–25. 25 ohm cartridge heater, 25 watt, ⅜″ (9.5mm) dia. × 1″ (25.4mm) long.

8271–11. Sensor/heater cable, 10 ft. (3m) long. Cable with a 24 pin, D-style locking receptacle with hood and cable clamp, and a dual banana plug for power output shield (6 pairs individually shielded).

8271–12. Sensor/heater/output cable. With buffered output and optional analog output. Additional construction is from 3 pairs of individually shielded cable.

Note: All standard sensor and heater cables are 10 ft. (3m) in length. Monitor output (instrumentation) cable is 6 ft. (1.8M) long. Longer cables may be special ordered at an additional charge per foot.

Call Lake Shore for details.

8072. IEEE–488 Interconnect cable (1m).

RM–3H1. Rack mounting kit to mount one 3–½″ (8.9cm) × 8″ (20.3cm) half-rack unit in a 3–½″ (8.9cm) rack space.

RM–3H2. Racking mounting kit to mount two 3–½″ (8.9CM) × 8″ (20.3cm) half-rack units in a 3–½″ (8.9cm) rack space. (for handles, add suffix -H to rack mount choice).

Table of Specifications for Input Conversion Modules

Sensor Input Conversion Module	Sensor Type	Temperature Range ±	Sensor Excitation Current	Sensor Input Range/ Resolution	Sensor Input Accuracy	Applicable Standard Sensor Response Curve	Monitor Output Signal	Sensor Use in Magnetic Fields
Standard Configuration	DT-470 or DT-500 (3V Diodes)	1.4 to 325K or 1.4 to 475K	10 μA	0-3V/ 0.05mV	0.1mV	Curve 10 or DRC Curves D and E1	0-3V	Not Recommended
805-6*	TG-120 Series (6V Diodes)	1.4 to 325K	10μA	0-6.5V/ 0.1 mV	0.2 mV	No Standard Curve*	0.455 x Sensor Voltage	Error ⩽ 7% for B ⩽5T and T > 4K
805-P2	PT-100 Series (100 ohm platinum)	14K to 800K	1 mA	0-300Ω/ 0.005Ω	0.01Ω	DIN 43760	Sensor Resistance x 0.1mA x (-10)	Error ⩽ 1% for B ⩽2½T and T >40K
805-P3	PT-100 Series (1000 ohm platinum)	14K to 800K	0.1 mA	0-3000Ω/ 0.05Ω	0.1Ω	DIN 43760	Sensor Resistance x 0.1mA x (-10)	Error ⩽1% for B ⩽ 2½T and T > 40K
805-R1*	RF-800 Series (27 ohm) Rh-Fe	1.4 to 800K	3mA	0-100 Ω/ 0.003Ω	0.01Ω	No Standard Curve	Sensor Resistance x 3mA x (-10)	Not Recommended

* To read correctly in a temperature scale the 805-6 and 805-R1 sensor input modules must be ordered with calibrated sensors and the 8001 Precision Option (PROM).

± 1.4K to 325K (– 272 to 52 °C)
1.4K to 475K (– 272 to 202 °C)
14 to 800K (– 259 to 527 °C)
1.4 to 800K (– 272 to 527 °C)